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**PHOTONICS INDUSTRY**  
**AND**  
**RESEARCH CAPABILITY GUIDE**

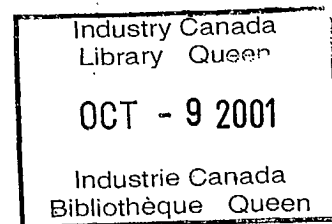
Industry

**Canada**

**PHOTONICS INDUSTRY**  
**AND**  
**RESEARCH CAPABILITY GUIDE**

Prepared for  
**Industry Canada**  
as part of the  
**Photonics Sector Campaign**

October 1993



## **PREFACE**

### **The Canadian Photonics Capability Guide**

This Canadian Photonics Capability Guide provides a current listing of the photonics activity in the country, and is intended to be used as a reference for locating photonics-based equipment, services and research capability in Canada. Altogether the Guide profiles 47 photonics companies and 23 research institutes, whose profiles were compiled with their active cooperation, and we wish, at this time, to thank the companies, institutes and universities that provided the information contained in this Capability Guide. It is divided into two parts: companies and research institutes.

Part I of the Capability Guide catalogues and describes companies involved in the business of photonics. Each profile provides the companies' address, contact names and numbers. It then gives an overview of the company under the headings of: nature of business, products/services, sales volume, number of employees, key customers and company background. The Preface contains a reference chart (Exhibit 1) of the companies included in the Capability Guide, listing them alphabetically and cataloguing the products and services they provide as well as their industrial application. In selecting companies to be included, a threshold sales volume of approximately \$2 million was used.

Part II outlines the photonics research activities and laboratory facilities of Canada's institutes and universities. In addition to their addresses, contact names and numbers, these profiles provide a general overview of the institute or university, a description of its organizational structure, the type of research being conducted and their industrial involvement. The reference chart for this section (Exhibit 2), which is contained in the Preface, lists the institutes alphabetically as well as defining its type and research topics. The institutes are categorized by the following: research consortia, non-profit institutes, government laboratories, university institutes and university laboratories.

We have tried to ensure the accuracy of the information provided. Since a guide of this nature cannot fully cover all the details and since some of the information can change, interested readers are invited to contact companies and organizations directly for detailed or current information. No confidential information has been included because of the wide distribution intended for this Guide. The publication of company and institutes names does not imply any government endorsement of an organization's capabilities.

Since this is the first edition of this directory, it has probably not captured all companies and research institutes in Canada with significant photonics capability. Organizations wishing to be included in future editions are urged to contact Industry and Science Canada.

## **Photonics emerging as recognized field**

Photonics, or advanced light-based technologies, has been identified as a strategic technology which will result in the advent of new equipment with capabilities that are impossible to obtain with any other technologies. Photonics has the potential to play as key a role in the next fifty years as electronics played in the last half of the century.

The worldwide production of photonics components, equipment and systems has been estimated at \$72 billion, and is forecast to increase to \$300 billion by the year 2000. Photonics is rapidly becoming a pervasive technology, with the potential for application in the following crucial areas of the Canadian economy: telecommunications and information technologies, aerospace, manufacturing, medical, automotive and energy sectors. Although its application is developing at different rates in each of these areas, the use of photonics technology is becoming increasingly critical to flexible manufacturing systems.

The federal government has identified photonics as an important enabling technology. It recognizes that the strong innovation potential and technological sophistication of the Canadian photonics industry must be aggressively developed and marketed if it is to compete in the global marketplace. The need to catalogue and assess Canadian photonics capabilities throughout the private sector, governments and universities was specified as an integral part of Industry and Science Canada's Photonics Sector Campaign. This first edition of the Canadian Photonics Capability Guide is a coherent compilation of photonics activities across Canada.

## **Canadian photonics sector**

The Canadian photonics sector consists of about 90 companies with a total photonics-related production of approximately \$1.2 billion annually. The industry is dominated by a small number of large companies, with ten per cent of the companies generating three quarters of the output. Along with a handful of large companies that produce photonics equipment as part of their product mix, there are numerous small companies that produce specialized components and equipment for niche markets.

The largest photonics application area in Canada is telecommunications, which accounts for approximately one half of Canada's photonics output. The leading companies in this sector include Northern Telecom, MPB Technologies, EG&G Optoelectronics Canada, JDS Fitel and Canstar Communications.

Another important sector is aerospace, which accounts for approximately one quarter of Canadian photonics production, led by CAE Electronics, Canadian Marconi, AlliedSignal and Spar Aerospace.

Most of the remaining Canadian production is in other manufacturing-related areas, in remote sensing equipment and in forestry sector equipment. The leading companies include Lumonics, the largest pure photonics company in Canada, and Hughes Leitz Optical Technologies.

There are three research institutes dedicated to photonics: the Solid State Optoelectronics Consortium, the National Optics Institute and the Ontario Laser and Lightwave Research Centre. There are also significant photonics research capabilities in other publicly supported research institutes, for example, TRILabs, the Canadian Institute for Telecommunications Research, the Telecommunication Research Institute of Ontario, the Communications Research Centre and the National Research Council, as well as in an industrial research laboratory, Bell-Northern Research.

Canada has substantial strength in the area of components. The development of components is often time and cost intensive. However, in the area of photonics, a product which can be categorized as an equipment or a subsystem, can often be developed relatively easily by combining readily available components, a niche product opportunity and a clever design. Some of the small companies have captured valuable business opportunities with this approach. The solid technology base in components could potentially serve Canadian industry very well.

### Exhibit 1: Canadian Companies with Photonics Capabilities

COMPANY	SALES VOLUME	PRODUCTS	APPLICATIONS AND CUSTOMERS	PAGE
Antel Optronics Inc.	\$3-5M	photo diodes, receivers, high-speed fiber-optic test equipment	telecommunications	I-1
Applied Physics Specialties	\$2M	precision optical components	aerospace, instrumentation, surveillance	I-3
Barringer Research Ltd.	\$4M	spectrometers and sensors	exploration, environment monitoring	I-5
Bomem	\$10-20M	infrared spectrometers	manufacturing quality control, research	I-7
CAE Electronics Ltd.	\$500M	flight and plant simulators, machinery control systems	aerospace, manufacturing, training	I-9
CREO Products Inc.	\$13M	data storage equipment, laser imagers	printing, data storage, government offices	I-11
DALSA Inc.	\$8-10M	CCD image sensors and modular expandable cameras	medical, manufacturing inspection	I-13
Diffraeto Ltd.	\$3M	surface inspection equipment	automotive and aerospace manufacturing	I-15
Dipix Technologies Inc.	\$3.5M	imaging products	inspections, medical imaging	I-17
Dynamic Control Systems	\$5M	vision systems, non-contact thickness sensors, veneer thickness profile system, edger, cant and trimmer optimisers	forest products machinery manufacturers and general manufacturing	I-19
EG&G Optoelectronics Canada	\$20-50M	semiconductor lasers, detectors	instrumentation, aerospace, telecommunications	I-21
EXFO E.O. Engineering Inc.	\$5-10M	fiber-optic test equipment	telecommunications	I-23
Fiberlign Inc.	N/A	fiber splicers, telecommunication systems	transportation, surveillance, energy, defence	I-25

COMPANY	SALES VOLUME	PRODUCTS	APPLICATIONS AND CUSTOMERS	PAGE
Fitel-Photomatrix Inc.	\$1-3M	test, monitoring and transmission equipment	telecommunications	I-27
Focal Technologies Inc.	\$3M	fiber-optic rotary joints, oceanographic instruments	marine surveillance	I-29
Gentec Inc.	\$13.5M	laser powermeters, laser diagnostic systems	instrumentation	I-31
George Kelk Corp.	\$12M	gauges, sensors	steel mills	I-33
Hughes Leitz Optical Technologies Ltd.	\$63M	lenses, optomechanical and electro-optical instruments	instrumentation, defence, manufacturing, entertainment	I-35
Interoptics	\$3-10M	coatings for optical components	instrumentation	I-37
ITRES Research Ltd.	\$1-3M	imaging systems using CCD	surveillance, research	I-39
JDS-Fitel Inc.	\$20-30M	fiber-optic passive components, test equipment	telecommunications	I-41
Lumonics Inc.	>\$90M	lasers, laser-based processing, machining and marking systems	electronics, aerospace, medical, manufacturing, automotive	I-43
MacDonald Dettwiler and Associates Ltd.	\$85M	optical sensors, aeronautical information systems, surveillance and communications systems	aerospace, geographic survey and defence agencies	I-45
Mayan Automation Inc.	\$1-3M	inspection, measurements, and object recognition systems	manufacturing	I-47
MPB Technologies Inc.	\$30M	lasers, sensors, undersea multiplexer	environmental, aerospace, telecommunications	I-49
MPR Teltech Ltd.	\$62M	telecommunications systems and services	telecommunications	I-51

COMPANY	SALES VOLUME	PRODUCTS	APPLICATIONS AND CUSTOMERS	PAGE
MVS Modular Vision Systems Inc.	\$2M	image processing systems	manufacturing, inspection	I-53
Newnes Machine Ltd.	>\$50M	laser-based thickness and profile sensors, optical and laser-based processing optimization systems	forest products manufacturers	I-55
Northern Telecom Ltd.	\$10B	digital switching and transmission systems	telephone operating companies, interexchange carriers, corporations worldwide	I-57
Optech Inc.	\$6M	laser rangefinders	surveillance, defence, environmental	I-59
Opto-Electronics Inc.	\$2M	high-speed fiber-optic test equipment	instrumentations for telecommunications, aerospace and defence	I-61
Optotek Ltd.	\$2-3M	semiconductor components	printing, display	I-63
OZ Optics Ltd.	\$2-5M	fiber-optic passive components	telecommunications, medical, defence, manufacturing instrumentations	I-65
Phillips-Fitel Inc.	\$10-20M	optical ground wire	telecommunications, utility companies	I-67
Photon Systems Corp.	\$2-3M	video transmission systems	telecom, surveillance	I-69
Pocatec Ltd.	\$1-5M	traffic light control, education kit	transportation, education	I-71
Porter Engineering Ltd.	\$5M	optimization software, tree length log bucking, scanning and process control	forest products machinery, food industry	I-73
Powerlasers Inc.	\$1-3M	laser welding heads	automotive and electronics manufacturing	I-75
Seastar Optics Inc.	\$4.5M	packaged laser diodes and power supplies	defence, telecommunications	I-77



COMPANY	SALES VOLUME	PRODUCTS	APPLICATIONS AND CUSTOMERS	PAGE
Sensor Adaptive Machines Inc.	\$2M	machine vision systems	automotive and aerospace manufacturing	I-79
Servo-Robot Inc.	\$2-5M	machine vision systems	manufacturing	I-81
SOFTAC Systems Ltd.	>\$3M	laser and camera-based vision scanning systems and robotics controls	forest products equipment manufacturers	I-83
The Optikon Corp. Ltd.	\$5-10M	light sources, lightmeters and test systems	electronics, automotive, telecom, defence, research	I-85
United Industrial Products/ Forestline Electronic Products Ltd.	\$2M	quality control equipment: high-speed optical grade-mark readers, log scanning systems, mill monitoring equipment	forest products industry	I-87
VisionSmart	\$1-3M	visual inspection systems	manufacturing and forest products	I-89
Vortek Industries Ltd.	N/A	high-power arc lamps	industrial and entertainment lighting	I-91
Waterloo Scientific Inc.	\$1-5M	test equipment for semiconductor and optoelectronic materials	research, semi-conductor manufacturing	I-93

## Exhibit 2: Canadian Research Institutes with Photonics Capability

INSTITUTE	TYPE	RESEARCH TOPICS	PAGE
Bell-Northern Research Ltd.	industrial	system design and testing of long-distance, high-speed transmission systems, and optoelectronic component development	II-1
Canadian Institute for Telecommunications Research	university Centre of Excellence	photonic interconnection technology, large ATM switching fabrics and high-performance digital computers	II-28
Canadian Institute for Broadband and Information Network Technologies Inc.	university-owned research corporation	fiber-optic network for broadband and multi-media services, development of universal fiber-optic network and fiber-to-the-desk network systems	II-38
Communications Research Centre	government	passive components based on fiber and planar waveguide, high-speed optoelectronic circuits	II-16
Defence Research Establishment Valcartier	government	application of optics and electronics to surveillance, target detection and identification, fire control and counter measures	II-19
Ecole Polytechnique	university	fiber-based components, passive and active components based on glass, lithium niobate and polymers, semiconductor optoelectronic device fabrication	II-47
McMaster University Centre for Electro-Photonic Materials and Devices	university	optoelectronic materials, devices, device technologies and integration	II-45
National Optics Institute	non-profit institute	optical system design, laser applications, information processing, processes for optical materials and coatings, fiber applications and sensors	II-6

INSTITUTE	TYPE	RESEARCH TOPICS	PAGE
National Research Council Canada Industrial Materials Institute	government	optical sensors for on-line quality and process control in materials processing industries	II-11
National Research Council Canada Institute for Microstructural Sciences	government	semiconductor material processing, new components and their applications and photonic materials	II-13
National Research Council Canada Institute for Information Technology	government	high-speed signal/image processing and sensing systems, optical interconnection	II-9
Ontario Centre for Materials Research	university Centre of Excellence	optoelectronic integrated circuits for optical communications systems	II-34
Ontario Laser and Lightwave Research Centre	university Centre of Excellence	photonic devices for telecommunications applications, optical data storage, non-linear phenomena and optical inspection systems	II-36
Solid State Optoelectronics Consortium of Canada	consortium	high-speed integrated optoelectronics components based on indium phosphide and gallium arsenide, e.g. wavelength-division-multiplex transmit-receive modules, new diode lasers, harmonic generation	II-3
Telecommunications Research Institute of Ontario	university Centre of Excellence	new optical communications methods, networking and optical component design	II-31
The Laser Institute	non-profit institute	laser applications in materials processing, sensors, profilametry, printing and displays	II-21
TR Labs	consortium	high-capacity optical transmission, photonic switching for broadband signals, integrated optical interconnections, optical subscriber systems and optical sensing	II-24
Université Laval Centre for Optics Photonics and Lasers	university	lasers and guided optics, optical communications, photonics, image science and nonlinear optics	II-43

INSTITUTE	TYPE	RESEARCH TOPICS	PAGE
University of Montreal and École Polytechnique Thin Films Group	university	indium phosphide-based device fabrication, ion exchange and ion implanted waveguides, diamond-like coating	II-52
University of Ottawa	university	optical backplane, coupler design, computer vision systems for flexible manufacturing, medical applications of lasers	II-54
University of Toronto Acousto-optic Research Laboratory	university	optical image and signal processing, fabrication of ultra-fast detector, integrated optical spectrum analyzer	II-50
University of Toronto Photothermal and Optoelectronic Diagnostics Laboratory	university	non-destructive material inspection methods for solid state and semiconductor materials	II-40
University of Western Ontario Laser and Electro-Optics Laboratory	university	near and far infrared lasers and associated electro-optical and electromechanical devices and systems	II-56

## **PART I: INDUSTRY PROFILES**

## ANTEL OPTRONICS INC.

3310 South Service Road  
BURLINGTON ON L7N 3M6  
CANADA

Tel: (416) 637-9990  
Fax: (416) 637-3530

Contacts: A. F. Strifler, President  
D. Kinsey, Vice President, Manufacturing

### Nature of Business

Antel Optronics Inc. designs and manufactures fiber-optic test equipment and optoelectronic instrumentation.

### Products/Services

Antel Optronics Inc. designs and manufacturers the following products:

- *High-speed photonic instrumentation* involving picosecond laser and detector systems and GHz optical fiber test systems;
- *Fiber-optic test equipment* involving long-haul and high-resolution PC-based OTDR and remote optical time-domain reflectometers (OTDR) for fiber sensor systems and line monitoring; and
- *Semiconductor components* involving OEIC receivers, high-resistivity silicon PIN photo diodes and custom photodiode arrays and hybrid assemblies.

**Sales Volume:** \$3-5 million

**No. of Employees:** 35

**Key Customers:** Telephone, CATV and data communication companies, government and private research laboratories.

**Company Background**

Incorporated in 1985 to develop and commercialize high-speed photodetectors and optoelectronic assemblies, Antel pioneered and is considered the world leader of PC-based fiber test instrumentation. In January 1993, Antel formed a strategic alliance with the 3M Corporation to market and jointly develop fiber test equipment.

## **APPLIED PHYSICS SPECIALTIES**

17 Prince Andrew Place  
DON MILLS ON M3C 2H2  
CANADA

Tel: (416) 445-1870  
Fax: (416) 445-7977

Contact: Martin High, President

### **Nature of Business**

Applied Physics Specialties (APS) manufactures precision optical components and assemblies for instrument manufacturers and for the surveillance industry.

### **Products/Services**

APS is a fully integrated optical fabrication house offering:

- optical coatings for visible and infrared components;
- single-point diamond turning of Ge, Al, Cu, ZnSe and plastics;
- optical polishing; and
- optomechanical design.

APS is a major supplier of assembled infrared lenses.



**Sales Volume:** \$2 million

**No. of Employees:** 22

**Key Customers:** SPAR Aerospace, Bomem Inc., IMAX Systems, ISTECH, Valmet Automation

### **Company Background**

Established in 1964, APS' early products included photo-typesetting masters and components for card reading equipment. In the 1980s, significant investment was made in modern polishing, testing, coating, machining and designing equipment. APS installed the first three-axis diamond turning machines in Canada and produced the first commercial hard carbon coating. All operations, machining, polishing, diamond turning and coating are done at APS.

APS will continue its developments in coating, diamond turning and computer controlled polishing. Future products include infrared surveillance lenses, precision machining of aspheric surfaces in glass and computer-controlled polishing of aspheric and rationally asymmetric surfaces.

APS works closely with several of its major clients in the development and specification of processes and components, and has a formal agreement with the Institute for Space and Terrestrial Studies of the University of Toronto to develop an infrared instrumentation package.

## **BARRINGER RESEARCH LIMITED**

304 Carlingview Drive  
REXDALE ON M9W 5G2  
CANADA

Tel: (416) 675-3870  
Fax: (416) 675-3876

Contact: Robert K. Ritchie, Chief Scientist

### **Nature of Business**

Barringer Research Limited carries out contract instrumentation R&D and manufactures and markets instruments arising out of these R&D programs.

### **Products/Services**

Barringer's main photonics-related products are:

- COSPEC UV/Visible Correlation Spectrometer for remote sensing of SO<sub>2</sub> and NO<sub>2</sub> emissions from stacks and volcanoes;
- GASPEC IR Gas Filter Correlation Spectrometer for remote sensing of trace atmospheric gases;
- airborne laser fluorosensors for oil spill detection and oil exploration; and
- reflectance radiometers and spectrometers for earth science studies.

**Sales Volume:** \$4 million, of which 25% is for photonics products and services

**No. of Employees:** 40 to 50

**Key Customers:** Volcanologists, Environment Canada

**Company Background**

Formed in 1961, Barringer Research Limited initially specialized in developing geophysical, geochemical and analytical instruments for the earth science, resource exploration and environmental markets, based on internationally recognized expertise and proprietary technology in the areas of electro-optics, magnetics, remote sensing and atmospheric physics.

Barringer's current focus is on IONSCAN Ion Mobility Spectrometers for the detection of concealed explosives and illicit drugs, but photonics and magnetic instruments continue to be sold and selectively developed.

## **BOMEM/Hartmann & Braun**

450 avenue St-Jean Baptiste  
QUEBEC QC G2E 5S5  
CANADA

Tel: (418) 877-2944  
Fax: (418) 877-2834

Contact: G. Vail, President

### **Nature of Business**

BOMEM designs, manufactures and markets high performance analytical instruments for research and quality control.

### **Products/Services**

BOMEM's products include *infrared spectrometers*: a grating spectrometer for chemical analysis and a Michelson interferometer high-resolution spectrometer for quality control and research use.

Other instruments of BOMEM's include a hydrogen analyzer and a particle counter for molten aluminum.

**Sales Volume:** \$10-20 million.

**No. of Employees:** over 100

**Key Customers:** manufacturing industries, industrial and government laboratories and universities world wide

### **Company Background**

BOMEM was established in 1973 based on infrared instrumentation technology. It is currently fifth in total sales among its worldwide competitors worldwide in the field of instrumentation for scientific research quality control and education. BOMEM has received several awards: "Exportation Awards" in the 1987 Mercuriades from the Quebec Chamber of Commerce and "Company of the Year" from the Electronics Industry Council of Quebec in 1988, and it was the finalist in the 1988 Mercuriades from the Quebec Chamber of Commerce.

## **CAE ELECTRONICS LTD.**

8585 Cote de Liesse  
SAINT-LAURENT QC H4L 4X4  
CANADA

Tel: (514) 341-6780  
Fax: (514) 341-7699

Contact: J. Overton, Manager Manufacturing Engineering

### **Nature of Business**

CAE Electronics Ltd., a subsidiary of CAE Industries Ltd., is the world leader in the development and production of electronic simulation and training devices for commercial airlines, the military and space agencies.

### **Products/Services**

CAE develops and produces flight simulators, power plant simulators, shipboard machinery control systems, supervising control and data acquisition systems, visual systems, fiber-optic helmet-mounted displays, telerobotics, and magnetic anomaly detection equipment.

Most of the above mentioned products involve photonics technologies in the form of visual display systems. Currently, CAE builds four different types of visual display systems depending on the applications:

- wide display consisting of projection, mirrors and screen;
- pupil-forming display;
- classical infinity display; and
- fiber-optic display.

The technologies, which were originally developed for flight simulators, are now used for a wide variety of other products and applications, such as remote piloting (telerobotics), virtual reality applications, and sensing (magnetic anomaly detection for geological survey and submarine detection).

**Sales Volume:** \$500 million

**No. of Employees:** 3400

**Key Customers:** major commercial airlines worldwide, governments of Canada, the U.S., Holland, Germany, Italy, Israel, Singapore, Turkey, Thailand and Australia.

### **Company Background**

As Canadian Aviation Electronics Ltd., it began operation in 1947 with the repair and overhaul of electronics and electro-mechanical equipment. By 1950, the company had advanced to a state of full involvement in the design, development and production of flight, radar and weapons simulation for the Armed Forces of Canada and other NATO members. In 1962, the company began an acquisition and diversification program to reduce the dependence on defence-oriented business. In 1963, the corporation name was changed to CAE Industries Ltd., with CAE Electronics as the largest subsidiary.

## **CREO PRODUCTS INC.**

110 Discovery Park  
3700 Gilmore Way  
BURNABY BC V5G 4M1  
CANADA

Tel: (604) 437-6879  
Fax: (604) 437-9891

Contact: Dan Gelbart, President

### **Nature of Business**

CREO develops and manufactures high-precision electro-optical products based on proprietary technology, particularly, optical data storage equipment and laser imagers.

### **Products/Services**

CREO develops and manufactures devices using precision mechanics, optics and electronics.

CREO produced the world's first Optical Tape Recorder, which uses patented methods of recording and reading data at ultra-high density. A single 12" reel of tape holds a terabyte of data, equivalent to 5,000 reels of conventional magnetic tape. The Recorder has a rapid data-transfer rate of three megabytes per second, as well as fast data access time of under 30 seconds. At a cost of about half a cent per megabyte, the Optical Tape Recorder is a very inexpensive way to store large volumes of data.

Imaging products include a precision photoplotter for use in printed circuit board manufacturing. This plotter, which features innovative 32-beam laser technology, is the fastest and most accurate plotter on the market.

Its other current products are:

- Large format photoplotters for the printing industry;
- Laser arrays for direct write applications.



**Sales Volume:** \$13 million

**No. of Employees:** 120

**Key Customers:** Dai Nippon Screen, Orbotech, Canada Centre for Remote Sensing, and many foreign governments

### **Company Background**

CREO was founded in 1983 with the specific objective of developing and manufacturing proprietary electro-optical products. In its early years, CREO was primarily a custom-design and manufacturing operation; a major activity was the development of an optical inspection machine for a California-based client.

In 1986, CREO was contracted by the Canadian Government to complete the development of the Optical Tape Recorder and to supply a total of seven machines. The first reproduction unit of the Optical Tape Recorder was delivered in 1990. Deliveries of the photoplotter commenced in 1989.

All of CREO's products are based on patented technologies, and most of them are manufactured for other companies who incorporate them into the finished products.

## **DALSA INC.**

605 McMurray Road  
WATERLOO ON N2V 2E9  
CANADA

Tel: (519) 886-6000  
Fax: (519) 886-8023

Contact: Rob Ambrose, Information Systems Supervisor

### **Nature of Business**

DALSA develops and manufactures high-performance solid-state CCD image sensors and modular expandable cameras.

### **Products/Services**

DALSA has a product line of image sensors and modular expandable cameras that are used in machine vision, document capture, medical and scientific imaging, surveillance, process monitoring and manufacturing inspection. They are based on the following proprietary technologies:

- CCD MEGASENSOR™ high-resolution sensor and camera technology, which is ideal for machine vision, document capture, and medical and scientific imaging;
- CCD TURBOSENSOR™ line-scan and area-scan technology, which uses an advanced CCD shift register profiled for high-speed operation, and is ideal for high-speed inspection and document scanning;
- CCD QUIETSENSOR™ time-delay and integration (TDI) line-scan technology for high-sensitivity and low-noise operation under low light-level conditions, which is ideal for scanning and inspection applications requiring high spatial resolution at a high data-transfer speed under low-light conditions; and
- CCD DYNASENSOR™ technology with a dynamic range of more than 1,000,000:1, which is suitable for applications requiring wide optical dynamic range, such as welding vision and space applications.

DALSA also develops customized products for specific customers and applications.

**Sales Volume:** \$8 to \$10 million

**No. of Employees:** 70

**Key Customers:** Kodak, Dupont, Quad Graphics, IBM, NCR

**Company Background**

DALSA was established in 1980 to pursue advanced CCD design, and now has a product line of over 100 image sensors and cameras. Its products are manufactured in 25,000 sq. ft. custom design facilities, which are equipped with specialized anti-static class 100 clean rooms.

Sales and export of custom and standard products worldwide are done through an agent network. DALSA has approximately 80 sales representatives in 40 sales offices worldwide. DALSA also has alliances in specialized markets.

## **DIFFRACTO LIMITED**

2835 Kew Drive  
WINDSOR ON N8T 3B7  
CANADA

Tel: (519) 945-6373  
Fax: (519) 945-1467

Contacts: Omer L. Hageniers, President  
Steve Dawson, Vice-President, Sales and Marketing

### **Nature of Business**

Diffraction Limited is involved in the development, production and sales of electro-optical inspection and measurement systems. Its target markets are surface quality detection in the automotive industry and non-destructive inspection in the aircraft industry.

### **Products/Services**

Diffraction offers the following D Sight™ products for surface defect detection in the automotive industry: the Audit Station (AS-2), the D Sight Portable (Series 3 & 7) and the Test Plaque Station (TPS). These products are used on "Class A" panels, made out of both steel and plastic, with particular software packages optimized for either of the materials. These products represent state-of-the-art in automotive surface quality determination.

Diffraction is working on automated on-line implementations of D Sight to allow "Body in White" inspection at the sheet metal repair area. Diffraction is also developing D Sight implementations that are optimized for aircraft inspection, particularly for inspection of impact damage on composite components and corrosion detection on aluminum structural components.

**Sales Volume:** \$3 million

**No. of Employees:** 25

**Key Customers:** General Motors, Ford, Fiat, VW, Toyota, Honda, Chrysler, Budd, Gencorp, Rocketdyne, General Electric, Babcock and Wilcox

### **Company Background**

Diffrauto has 20 years of experience in the application of state-of-the-art electro-optical technology to measurement and inspection. The company's areas of expertise include high-speed on-line gauging systems at accuracies down to 0.001 mm; gauging of complex parts such as jet engine turbine blade contours to 0.0005 mm; and surface imperfections on large surfaces (1 m<sup>2</sup>) at a depth of 0.002 mm.

Diffrauto holds over 80 patents worldwide on electro-optical inspection and measurement techniques. In particular, the patented "D Sight" process is a unique optical process, extremely useful in automotive and aerospace surface quality inspection. The company has won numerous awards, such as the Chrysler Pentastar, 1990 and the Canada Award for business Excellence, Silver Award, in 1988.

Diffrauto has its own sales force in North America. In Europe, it uses distributors and agents on a country-by-country basis. In Japan, it has a licensing agreement with a Japanese manufacturer.

## **DIPIX TECHNOLOGIES INC.**

1050 Baxter Road  
OTTAWA ON K2C 3P1  
CANADA

Tel: (613) 596-4942  
Fax: (613) 596-4914

Contacts: Paul R. Pearl, President  
Vijay Dube, Director of Sales & Marketing

### **Nature of Business**

Dipix Technologies Inc. supplies electronic imaging products (hardware, software systems) for the vision market.

### **Products/Services**

Dipix Technologies manufactures an innovative line of imaging products, ranging from imaging boards and software for PCs to large end-user system solutions servicing various imaging needs. It has the following three product divisions:

- The Vision Products Division sells high-performance imaging boards to OEMs and VARs active in the fields of industrial inspection, machine vision and medical imaging.
- The Custom Vision Products Division customizes vision products for specific customer needs.
- The Industrial Imaging and Systems Division develops unique vision solutions for end users, such as the recent Machine Vision Package developed for the Bank of Canada to inspect bank notes.

**Sales Volume:** \$3.5 million

**No. of Employees:** 29

**Key Customers:** OEM customers (such as Gillette, Amber Engineering, Ford, General Electric, Hughes), the Bank of Canada, United Parcel Service

**Company Background**

Dipix is an electronic imaging company with its head office and manufacturing facilities in Ottawa, Canada. Since its inception in 1978, Dipix has established an international network for supporting its customer base in over 25 countries.

## **DYNAMIC CONTROL SYSTEMS**

#205-7088 Venture Street  
DELTA BC V4G 1H5  
CANADA

Tel: (604) 940-0141  
Fax: (604) 940-0793

Contacts: Leonard Metcalfe, President  
Barry Dashner, General Manager

### **Nature of Business**

Dynamic Control Systems, under the "DynaVision" trade name, is a leader in the manufacturer of laser and non-laser-based vision systems and sensor technologies for robotics, measurement, process control and quality control applications.

### **Products/Services**

The company has particular expertise in sawmill control systems, focusing on laser profile scanning and lumber recovery optimization for board edgers, cant edgers, and trimmers.

- vision systems (including a 3-D log profiling scanning system) and associated optimization software
- DynaVision non-contact thickness sensors for quality control systems, (including a 3-D board and cant profile system, veneer thickness profile system, aluminium ingot profiler
- edger, cant, and trimmer optimisers
- machine tool and broken bit detectors, photocell curtains



**Sales Volume:** \$5 million

**No. of Employees:** 12

**Key Customers:** Clients include major forest products machinery manufacturers and forest products companies throughout North America and extending to Europe, New Zealand and Australia. Non-forest industry clients include Alcoa and Ingersoll Milling Machine Co.

### **Company Background**

Dynamic Control Systems has provided industrial control products and services since its inception in 1976. With an initial emphasis on serving the softwood processing sector of the forest products industry, the company now provides cross machinery controls for the paper industry and laser-based vision systems and sensors for general manufacturing applications. Dynamic Control Systems utilizes CAD technology for electronic and mechanical design of sensors and CNC machining techniques.

Distribution is through OEM manufacturers who sell to forest products companies. The company's 3-D log profiling system is distributed exclusively by Eaton Corporation through their subsidiary, Opcon, which controls an 80% share of the market for log scanning applications in the U.S.

Dynamic Control Systems is a division of Dynamic Systems Group Inc. and is a wholly owned Canadian Subsidiary.

## **EG&G OPTOELECTRONICS CANADA**

22001 Dumberry Road  
VAUDREUIL QC J7V 8P7  
CANADA

Tel: (514) 424-3300  
Fax: (514) 424-3411

Contact: Ron Swarbrick, General Manager

### **Nature of Business**

EG&G Optoelectronics Canada manufactures state-of-the-art electro-optical components and sub-systems for use in applications, such as laser range finding, optical proximity fusing, target designation and tracking, line-of-sight and fiber-optic communications, measurement and controls.

### **Products/Services**

EG&G's products include:

- GaAs, GaAlAs, InGaAs and InGaAsP semi-conductor injection lasers, laser arrays, infrared emitters and transmitter modules;
- silicon and InGaAs PIN photodetectors, avalanche photodetectors; and
- hybrid detector preamplifier assemblies and receiver modules manufactured using the latest silicon and III-V compound technologies.

To ensure device performance, leading-edge technology is tailored to individual customers' requirements. For example, EG&G's unique APD structure and proprietary processing have been optimized for applications from very low-light photon counting, to Nd:YAG receivers requiring 1060 nm response, to systems requiring GHz frequency response.

Over 70% of EG&G's production is of non-catalogue devices and packages. A range of levels of assembly automation is available at the Vaudreuil facility, ranging from hand assembly using precision jigs to automated furnaces that permit reproducible, high-volume production of tens of thousands of components per month.

**Sales Volume:** \$20 to \$50 million

**No. of Employees:** 180

**Key Customers:** Major U.S. and European defence, aerospace and communications companies

### **Company Background**

The capability of EG&G Optoelectronics Canada (formerly GE/RCA Inc., Electro Optics) evolved from emitter technology originating at the David Sarnoff Research Center, Princeton, N.J. and detector technology pioneered by RCA in Montreal, Que. In 1986, the emitter and detector operations were consolidated in Vaudreuil, Que. in an ultra-modern research and manufacturing facility that incorporates extensive clean room fabrication and test areas, one of the most advanced of its kind in North America. Operating under the strict EG&G Reliability Assurance system, it can meet the most stringent customer requirements to AQAP and other MIL-Spec standards.

Material and device characterization is an integral control aspect of EG&G's operations. This includes direct SEM photograph, energy dispersive X-ray analysis of composition, electron-beam induced current identification of depletion regions, X-ray diffraction to monitor lattice matching in epitaxial growth, photoluminescence to determine III-V compositions and Polaron and C-V analysis to determine doping profiles.

EG&G Optoelectronics Canada has sales offices in the U.S. and Europe and has distributor agreements covering Europe and the rest of the world.

## **EXFO E.O. ENGINEERING INC.**

465 Godin Avenue  
VANIER QC G1M 3G7  
CANADA

Tel: (418) 683-0211  
1-800-663-EXFO  
Fax: (418) 683-2170

Contact: Germaine Lamonde, President

### **Nature of Business**

EXFO E.O. Engineering Inc. (EXFO) manufactures fiber-optic test equipment for network installers and service companies, telephone companies and R&D laboratories.

### **Products/Services**

EXFO manufactures a comprehensive selection of fiber-optic test equipment: power meters, LED and laser sources, variable attenuators, variable back-reflectors, back-reflection test sets, visual fault locators, dual wavelength test systems, single fiber Voice Communication system VCS-20A and the new OTDR on a PC card.

EXFO's instruments are designed to serve three main market segments:

- the LAN, FDDI, ISDN, SONET etc. network installers and service companies;
- long haul (telephone companies, public utilities, undersea cabling, CATV); and
- research laboratories.

EXFO supplies a complete range of instruments to serve the main segments of the telecommunications industry (telephony, data transmission and laboratory):

- hand held power meter with dual LEDs or dual laser sources, software-controlled offsets correction and automatic data acquisition/recall;
- hand held single fiber voice communication set, with multi-party communication possible and full duplex over one fiber;
- test instruments operating on three power sources; and
- RS-232 Interface control of sources, attenuators and meters.

**Sales Volume:** In the \$5 to \$10 million range

**No. of Employees:** 105

**Key Customers:** Bell Atlantic, Michigan Bell, GTE, U.S. West, Bell Canada, Bell South, SNET, SIP, BT, Northern Telecom, NYNEX, AT&T

### **Company Background**

EXFO E.O. Engineering was established in 1985 to design and manufacture high quality high-end fiber-optic field test equipment. Through numerous product innovations and the unprecedented reliability of its units, EXFO is now recognized in both the North American and European markets as a leader in innovative fiber-optic test equipment. EXFO collaborates in research and development projects with the National Institute of Optics and the Optics Department, Laval University.

EXFO has received awards for the excellence of its products and for its continued progress (Canadian Advanced Technology Association, Canadian High Tech Show, etc.)

EXFO has 20 sales organizations representing its products in the U.S., with offices in Texas, North Carolina, Illinois and Pennsylvania. EXFO is represented overseas by 25 distribution companies and has a European sales office. Its products are distributed in over 40 countries around the world.

## **FIBERLIGN INC.**

24 Colonnade Road  
OTTAWA ON K2E 7J6  
CANADA

Tel: (613) 226-4000  
Fax: (613) 226-4602

Contacts: G. Boyle, President  
R. Levasseur, Director, Marketing

### **Nature of Business**

Fiberlign designs and manufactures a portfolio of fiber-optic communications and fiber splicing products for worldwide distribution.

### **Products/Services**

These products include:

- a video transmission portfolio with point-to-point and multichannel;
- voice and data products with point-to-point, modems and multiplexers;
- installation equipment with fusion splicers, cleavers, etc.

**Sales Volume:** not available

**No. of Employees:** 50

**Key Customers:** *Applications:* Freeway traffic management systems, rapid transit and airport surveillance systems, SCADA for power utilities and numerous security applications including military and power utility sectors.

*Examples:* Hwy 401: Video surveillance and data collection and distribution systems.

*N.Y. Airports:* Revenue control and access validation to Kennedy, La Guardia and New Jersey airports.

*U.S. Dept. of Defence:* Fiberlign's optical converters are used as satellite entrance links.

### **Company Background**

Established in 1977 as Foundation Instruments (FI), the company was initially involved in designing electronic systems for military applications. Through engineering innovation and manufacturing know-how, FI soon developed a reputation for reliable products and participated with Bell Canada in a 1978 fiber-optic experiment in Yorkville. From that time, FI quickly emerged as one of the new up-and-coming high technology companies, solely dedicated to fiber-optic applications.

## FITEL-PHOTOMATRIX INC.

199 Colonnade Road  
NEPEAN ON K2E 7K3  
CANADA

Tel: (613) 723-8939

Fax: (613) 723-8349

Contact: F. D. King, President

### Nature of Business

Fitel-Photomatrix Inc. also known as F-PMX is in the business of design, development and manufacturing of test, monitoring and transmission equipment for fiber-optics telecommunications. The main thrust of the business is to design and package the equipment as a sub-system within the transmission systems or as an integrated part of the installation and maintenance facilities.

### Products/Services

The product line and the typical applications of Fitel-Photomatrix are:

- *test and installation support equipment*
  - a clip-on talk-set for cable splicing and cable repairs which is capable of transmitting not only voice but also data communication
  - a set for fiber ribbon cable
  - a talk set
  - a cable identification unit based on polarization modulation
- *remote OTDR monitoring equipment* which allows the field splicer to monitor the OTDR test results locally and to change the monitoring channel locally;
- *route diversity switch* which involves a subsystem based on an optical switch that can be permanently installed within transmission systems for the protection against cable cuts. Systems are also used for lab tests of transmission equipment; and
- *optical fiber amplifier* involving a compact erbium-doped fiber amplifier for board mounting.



**Sales Volume:** \$1-3 million

**No. of Employees:** 10-20

**Key Customers:** major telephone operating companies and research labs in the U.S., Canada, Europe and Asia

### **Company Background**

Fitel-Photomatrix was founded in 1988 as Photomatrix Inc. in order to develop and manufacture fiber-optic switches for re-routing. In 1991 when Furukawa Electric Co. Ltd. became the major share holder, the product line and geographic market size expanded substantially. Given the financial and marketing support, F-PMX is aggressively pursuing the business opportunities primarily for telecommunications in the areas of niche and advanced photonic instrumentation and sub-systems.

## **FOCAL TECHNOLOGIES INCORPORATED**

40 Thornhill Drive, Unit 7  
DARTMOUTH NS B3B 1S1  
CANADA

Tel: (902) 486-2263  
Fax: (902) 468-2249

Contact: Graham Smith, President

### **Nature of Business**

Focal Technologies is a world leader in the application of fiber-optic technology to demanding environments such as those found in marine and industrial markets.

### **Products/Services**

Focal Technologies manufactures electrical slip rings, fiber-optic rotary joints and fluid rotary unions. These products are used in winches and reels handling cables for remotely operated vehicles, towed sensor arrays, diver support systems and other undersea systems. The most successful oceanographic instrument is the Optical Plankton Counter, used to count and size zooplankton and to measure total phytoplankton.

These products are used in the offshore oil and gas sector, where Focal Technologies is the leader, and the rotary products are known as Nova Scotia Slip Rings. Other target markets include manufacturing plants having rotating work stations or machines requiring fiber-optic and other signals to be carried through the rotation, and radars with high frequency signals carried on optical fiber to serve rotating antennas.

**Sales Volume:** \$3 million

**No. of Employees:** 30

**Key Customers:** Perry Trittech Inc., MacArtney A/S, Halliburton, Subsea International, Sonsub Services, U.S. Navy.

### **Company Background**

Focal Technologies was established in 1983, focusing mainly on R&D of fiber-optic marine applications. In 1988, Focal Technologies began manufacturing a product line that included slip rings used in shipboard winches, via a licensing agreement with Nova Scotia Research Foundation Corporation. The following year it included an optical plankton counter via another licensing agreement.

The major achievements of Focal Technologies includes the world's first production multiple-pass fiber-optic rotary joint, the ability to combine such products with electrical slip rings and fluid rotary unions and to pressure-compensate all products for operation in high ambient pressures.

The main future thrust of the company is to expand the rotary product line to address new markets, requiring single-mode fiber-optic rotary joints and slip rings serving higher frequency, lower noise applications and having physical features such as hollow bores and higher temperature tolerance.

## **GENTEC INC.**

2625 Dalton Street  
SAINTE-FOY QC G1P 3S9  
CANADA

Tel: (418) 651-8000  
Fax: (418) 651-6695

Contact: Michel Giroux, Vice-President

### **Nature of Business**

Gentec is a manufacturer of instrumentation for the measurement of power and energy, as well as analysis of laser beams in many different fields, such as medical, scientific, industrial, military, etc.

### **Products/Services**

Gentec is one of the few companies that manufactures and distributes a whole range of equipment designed to measure and analyze a laser beam. In the early 1990s, the company launched, through its participation the Eureka project, a holographic laser beam sampler, which is used to extract multiple low-power beams from the main beam, facilitating the diagnostics and prediction of the laser's behaviour. Within the same project Gentec also developed a brand new type of detector which is used to make several simultaneous analyses from a single laser beam. Gentec also offers the SUN series of third-generation laser pulse measurement devices.

Gentec's line of photonics products includes the following range of state-of-the-art devices for sampling and monitoring subsystems that can be fully customized to meet any industrial laser application:

- laser energy meters
- laser power meters
- laser beam samplers (splitters)
- high voltage probes
- laser beam quality meters
- laser beam diagnostic systems

Gentec also provides OEM design services for laser beam monitoring and analysis.

**Sales Volume:** \$13.5 million

**No. of Employees:** 141

**Key Customers:** NEC, Siemens, Coherent, Lawrence Livermore National Laboratory

**Company Background**

Incorporated in 1959, Gentec Inc. has become one of the world leaders in its field of electro-optics, energy management, automation and controls. Gentec achieved this through its practical approach in building state-of-the-art technology with tangible solutions for practical applications. Gentec has acquired a strong reputation in energy control. In the early 1970s, Gentec entered the laser field, launching the very first joulemeter available on the market that measured a laser beam with great accuracy.

From its head office in Sainte-Foy, Quebec, Gentec has established an extended network of distributors and agents. Gentec's success can be traced to the quality of its manufacturing process and of its equipment.

## **GEORGE KELK CORPORATION**

48 Lesmill Road  
DON MILLS ON M3B 2T5  
CANADA

Tel: (416) 445-5850  
Fax: (416) 445-5972

Contacts: Peter Kelk, President  
Rob Ricciatti, Vice-President, Sales and Marketing

### **Nature of Business**

George Kelk Corporation (KELK) designs and manufactures electromechanical and optoelectronic sensors and gages for the metals-rolling industry, including both ferrous and non-ferrous mills.

### **Products/Services**

KELK produces a wide range of sensing equipment for rolling mills. Examples of its products that use photonics technology include:

- The ACCUPLAN Plate Outline Gage which accurately measures the complete plan view shape of hot slabs or plates between rolling passes, using the metal's own radiant energy. ACCUPLAN incorporates state-of-the-art optics and electronics and unique scanning and digital edge-detection techniques, achieving a measurement accuracy in two dimensions of better than 2 mm.
- The ACCUBAND Strip Width Gage and Crop Optimization Systems use high-accuracy stereoscopic video detection to continuously measure the width of hot or cold moving metal strip during the rolling process. Exceptionally fast head-end response and measurement speed exceed current requirements for modern automatic width control systems.

KELK also offers sensors and other custom equipment for the pulp and paper, nuclear, oceanographic and radio and television broadcast industries.

**Sales Volume:** \$12 million

**No. of Employees:** 110

**Key Customers:** Major steel mills in the U.S., Canada, Japan, U.K., France, South Korea, Finland, Austria, Spain, India, Mexico, China, etc.

### **Company Background**

George Kelk, the firm's founder, ventured into the manufacturing of custom measurement sensors for the steel industry in the 1950s. His innovative designs increased mill productivity and quality, and led to the introduction of optoelectronic gages and other mill sensors for a variety of industrial applications.

KELK is an acknowledged world leader in the design and manufacture of high quality sensors for the demanding rolling mill environment, and has diversified in other industries, introducing many innovative high-technology sensors capable of functioning within demanding environments.

In 1992, KELK won the Canada Award for Business Excellence - Innovation for the development of Accuband V.

## **HUGHES LEITZ OPTICAL TECHNOLOGIES LTD.**

328 Ellen Street  
MIDLAND ON L4R 2H2  
CANADA

Tel: (705) 526-5401  
Fax: (705) 526-5831

Contacts: Joseph De Remigis, President  
John W. Mactaggart, Vice-President, Marketing

### **Nature of Business**

Hughes Leitz Optical Technologies Limited (HLOT) designs and manufactures sophisticated optics, optomechanical and advanced electro-optical assemblies and instruments.

### **Products/Services**

HLOT manufactures a wide range of defence products, such as fire control systems, day/night sights, aerial reconnaissance lenses, periscopes, integrated sighting systems, optical and laser rangefinders, optical gunsights, head-up and helmet-mounted display optics (ANVIS), satellite data-gathering systems (WINDII/WAMDII, etc.

HLOT's products for civilian markets include microfilm lenses, underwater optical systems, laser scanners, machine vision systems, medical optics, optical data storage, nuclear reactor vault periscopes, cinematographic-taking lenses, high-performance projection lenses, etc.

HLOT also supplies filters, mirrors, windows, cube-corners, prisms, build-to-print and custom optical systems coating services, MTF test capability (EROS IV, Ealing), etc.



**Sales Volume:** \$63 million

**No. of Employees:** 425

**Key Customers:** Defence: Loral, McDonnell Douglas, General Dynamics, GEC-Ferranti, Lockheed, Hughes Electro-Optical Systems, Hughes Missile System Co., Canadian Government, U.S. Government, Eltro, Computing Devices, Sabca, Vinten, Sagem

Commercial/Industrial: Leica Camera, Polaroid, Hughes JVC, IMAX, COMDEV, Bossfilms, Electrosonic, Panovision

### **Company Background**

Hughes Leitz Optical Technologies Limited was established in Canada in 1952, and has set many benchmarks in the application of precision optical products in industry, medicine, photography, scientific research and defence programs.

Drawing upon nearly 40 years of experience, not only in North America but also worldwide, Hughes Leitz is one of the world's leading suppliers of custom-manufactured and build-to-print optical systems for civilian and government applications.

## INTEROPTICS

### Division of Lumonics Inc.

14 Capella Court  
NEPEAN ON K2E 7V6  
CANADA

Tel: (613) 224-4868  
Fax: (416) 224-2105

Contacts: J. Wimperis, President  
W. McCreath, Engineering Manager

### Nature of Business

Interoptics manufactures custom and standard precision optical components, and is responsible for the design and deposition of vacuum coatings for lasers and electro-optic instruments.

### Products/Services

Interoptics manufactures the following:

- *laser optics*: lenses, mirrors, windows and prisms which are fabricated to fractional wavelength tolerances. Components are manufactured from a wide variety of materials.
- *Interferometer components and instrumentation optics*: ultra high precision components are used in etalon, interferometer and other precision measurement equipment. The typical application is remote sensing, monitoring and analysis. Interoptics has facilities to produce diamond turned optics and thin films. Interoptics' precision diamond turning capabilities turn optical surfaces which are spherical, flat, or aspheric directly into a variety of plastic and crystal materials. Interoptics' in-house film design and deposition capabilities makes it a leader in the production of vacuum coatings for high-peak-power pulsed lasers and also for high-average-power laser applications.

**Sales Volume:** \$3-10 million

**No. of Employees:** 25-50

**Key Customers:** photonics and aerospace industries and research labs

**Company Background**

Established in 1973, the company was purchased by Lumonics Inc. in 1990. The excellence of the technologies has been demonstrated in the use of the components for high power lasers and for interferometer subsystems for satellite.

## **ITRES RESEARCH LTD.**

155, 2635-37th Avenue NE  
CALGARY AB T1Y 5Z6  
CANADA

Tel: (403) 250-9944  
Fax: (403) 250-9916

Contact: Clifford Anger, President

### **Nature of Business**

ITRES Research develops and manufactures systems using applications of charge coupled devices for cameras and imaging systems which operated in visible light, ultraviolet or near infrared ranges.

### **Products/Services**

ITRES has special expertise in digital electronic camera systems and charge coupled device technology. The featured product is the Compact Airborne Spectrographic Imager (*casi*), a visible to near infrared, user-programmable imaging spectrometer, which is offered for rent, lease or purchase. Applications can range from agriculture, forestry and land use to oceanographic, laboratory studies and environmental impact studies.

Ten instruments have now been sold or leased worldwide and are being used in a variety of applications, including assessing fish stocks to examining industrial development impacts on the environment. Further improvements are in progress to widen the spectral range of the *casi* and to provide map-transformed (geocoded) image data in a form which can be utilized directly by Geographic Information Systems (GIS).

ITRES is also engaged in contract R&D, electro-optical design and instrumentation.

**Sales Volume:** \$1 to \$3 million

**No. of Employees:** 16

**Key Customers:** Remote sensing companies, government agencies and universities

**Company Background**

ITRES Research Limited has been developing high quality electro-optical instruments for the scientific and remote sensing communities since 1979. In 1990, a wholly owned subsidiary ITRES Instruments Inc., was formed to handle the production, marketing and applications development of the *casi*. ITRES Instruments offers the *casi* for purchase, lease or short-term rental and engages in proof-of-concept *casi* missions using a twin-engine Cessna or customer-supplied aircraft.

## **JDS-FITEL INC.**

570 Heston Drive  
NEPEAN ON K2G 5W8  
CANADA

Tel: (613) 727-1303  
Fax: (613) 727-8284

Contacts: W. Sinclair, President  
J. Straus, VP Sales and Marketing

### **Nature of Business**

JDS-Fitel Inc. is in the business of manufacturing passive fiber-optic components and fiber-optic test instruments for the telecommunications industry. The majority of this company's products are based on micro-optics technologies. Its packaging technology and the associated skill have earned JDS-Fitel an excellent reputation for the quality and reliability of its products. JDS-Fitel Inc. is also a provider of a wide variety of fiber-optic instruments including connectors, splicers and amplifiers.

### **Products/Services**

The product line and the typical applications are the following:

- *Passive components* including switches, attenuators, wavelength division multiplexers, tunable bandpass filters, polarization splitters and combiners;
- *Fiber-optic test instruments* programmable multiport switches, insertion loss and back reflection meters, polarization sensitivity meters, variable back reflectors, high precision attenuators;
- *other instruments* including polishing machines for optical connectors, connectors with low return loss, fiber amplifiers.

**Sales Volume:** \$20-30 million

**No. of Employees:** 180

**Key Customers:** Equipment manufacturers: Northern Telecom, AT&T, Alcatel, Ericsson, Hughes, Lockheed, Boeing, Hewlett-Packard, Martin Marietta, Siemens.

Telephone companies: Bell Canada, BC Tel, Sask Tel, Bell South, Pacific Telesis, Illinois Bell, MCI, Sprint, Ameritech, Nynex, Williams Telecom.

Laboratories: Bellcore, Bell Labs, Bell-Northern Research, BT Research Lab, Fujitsu Lab, Hitachi Lab, NTT Lab, KDD Lab.

### **Company Background**

JDS-Fitel Inc. was founded in 1981 to serve the market for optical passive components and instruments for the rapidly growing fiber-optics industry. In 1990, the company entered into a strategic partnership with the Furukawa Electric Co. Ltd., which provides JDS R&D and manufacturing supports as well as the benefit of joint marketing in global scale.

## LUMONICS INC.

105 Schneider Road  
KANATA ON K2K 1Y3  
CANADA

Tel: (613) 592-1460

Fax: (613) 592-7549

Contacts: D. J. James, President, COO  
C. R. Avery, VP Finance

### Nature of Business

Lumonics is an international company specializing in the development, manufacture and sales of lasers and laser-based systems. The company combines laser and systems expertise to address customer applications in materials processing, product identification, scientific research and semiconductor processing.

### Products/Services

Lumonics specializes in:

- *Material processing laser systems for precision machining and materials treatment* which involves welding, drilling, cutting and surface treatment;
- *Laser marking systems* whose prime applications include date and lot coding of products and packages and serialization of semiconductor components in industries; and
- *scientific laser products* for use in research in photochemistry, spectroscopy and plasma physics applications, in addition to pulsed holography applications.



**Sales Volume:** Over \$90 million

**No. of Employees:** 600 in six manufacturing locations

**Key Customers:** Electronics, aerospace, automotive, packaging, beverage, pharmaceutical, advanced manufacturing and advanced research industries.

### **Company Background**

Lumonics was founded in 1970 and went public in 1980. Four acquisitions were made in the period from 1982 to 1987, each of which brought complementary technology and expanded geographic presence to the Lumonics group. In 1989, Lumonics was acquired by Sumitomo Heavy Industries Ltd. of Japan. Lumonics is the pioneer company and the market leader in laser marking, is the largest manufacturer of industrial YAG lasers, and is one of the five largest laser manufacturers in the global market place with 5000 installed systems worldwide.

## **MACDONALD DETTWILER and ASSOCIATES LTD.**

13800 Commerce Parkway  
RICHMOND BC V6V 2J3  
CANADA

Tel: (604) 278-3411  
Fax: (604) 278-2117

Contact: Bob Campbell, Director of Corporate Communications

### **Nature of Business**

MacDonald Dettwiler and Associates Ltd. (MDA) is a leading international systems engineering company which provides expertise consulting services, software development and systems development and integration.

### **Products/Services**

The company's activities have applications to geo-information, aviation, and space and defence systems including:

- development of optical sensors for the acquisition of remotely sensed airborne data;
- development of systems to acquire and process photonics-based data;
- GIS-related expertise in the use of photonics-based imagery for the purpose of analyzing land and environmental resources;
- aeronautical information systems, and air traffic management systems;
- surveillance, communications and logistics systems.

**Sales Volume:** \$85 million

**No. of Employees:** 800

**Key Customers:** The company's clients include governments and government agencies worldwide: Canada's Radarsat Program, Transport Canada, Department of Defence (Maritime Coastal Defence vessel program), Canadian Space Agency & the U.S. Space Station Program, U.S. Geological Survey, Norwegian Aviation Authority, Malaysian Dept. of Survey & Mapping, Japanese National Academy of Space, People's Republic of China Remote Sensing Centre, European Space Agency, and other agencies from Belgium and India

### **Company Background**

Founded in 1969, MDA is today a public company listed on the Vancouver Stock Exchange. The company expertise is in the design and delivery of systems engineering services (procurement, installation, operation and Maintenance) for applications related to niche markets within geo-information systems, aviation systems, and space and defence markets.

The company has developed land, resource and environmental management systems which utilize photonics-based airborne and satellite observation systems.

The company regularly teams with other leading aerospace suppliers including Hughes Aircraft Lockheed, Spar Aerospace and Systemhouse.

## MAYAN AUTOMATION INC.

2364 - 46th Avenue  
LACHINE QC H8T 2P3  
CANADA

Tel: (514) 636-5418  
Fax: (514) 636-3749

Contacts: Michael Braeuel, President  
Andre Sokalski, Technical Director

### Nature of Business

Mayan Automation provides a broad range of industrially hardened high-speed optical inspection, measurement and object recognition solutions to a wide variety of industries.

### Products/Services

Mayan Automation's products/services include the following:

- *Fine-Line™ High-Speed Line Array Cameras:* High speed CCD technology and expertise has provided a wide range of manufacturers with width measurement and web inspection solutions. Comprehensive system interfaces are designed to offer both reliable process control and SPC data collection.
- *Machine Vision Systems for packaging and assembly inspection:* These are successfully installed high speed two-dimensional vision systems for such diverse applications as pharmaceutical packaging, electronic connector and lottery ticket inspection. Turnkey installations provide the customer with fully engineered and integrated inspection solutions, including interfaces to existing process equipment and eject mechanisms.
- *Spectra-Mesh™ Weave Quality Monitoring for precision textiles:* Spectra-Mesh™ represents a significant innovation in the area of in-line weave quality monitoring. A patented optical configuration and signal processing method sense any unacceptable variation in a weave pattern and ensure zero defects.
- *Research and Development Services:* Feasibility studies and custom sensor development, development of customized interfaces for OEM customers.

**Sales Volume:** \$1 to \$3 million

**No. of Employees:** 10

**Key Customers:** Michelin Tires Ltd., Alcan Aluminum Ltd., Ciba Vision, Emil Jager GmbH, Dow Chemical Inc.

**Company Background**

Mayan Automation was founded in 1986 by machine vision experts to provide inspection and quality control solutions for manufacturing industries. Building on a solid base of experience with its own proprietary technology, Mayan has successfully adapted new vision system technologies and has installed more than 170 machine vision systems in North America and Europe.

Mayan's inspection systems have been used successfully for guaranteeing quality, increasing productivity and automating process control in such industries as pharmaceutical, food and beverage, precision textiles, glass, rubber and other manufactured products.

## **MPB TECHNOLOGIES INC.**

1725 North Service Road  
Trans Canada Highway  
DORVAL QC H9P 1J1  
CANADA

Tel: (514) 683-1490

Fax: (514) 683-1727

Contact: M.P. Bachynski, President

### **Nature of Business**

MPB Technologies Inc. specializes in high technology systems and products and in contract research and development.

### **Products/Services**

The photonics products/services offered by MPB Technologies include:

- undersea branching multiplexers for transoceanic and coastal optical-fiber telecommunication networks, fiber-optic amplifiers for repeater-less submarine telecommunication links, Er-doped fiber lasers and amplifiers;
- optical-fiber-based specialized technology, such as signal distribution and control of phased-array radar, high-speed swept frequency synthesizer and optical control of microwave devices;
- development of specialized optical-fiber sensors for robotic applications and smart structures, hydrophone and environmental sensors, aircraft fly-by-night sensors;
- CO<sub>2</sub> lasers, 7-8  $\mu$ m wavelength HeNe lasers, excimer lasers, multi-wavelength and multi-pulsewidth solid-state Orion lasers, LIDARs, laser systems for materials processing, non-destructive testing and environmental analysis;
- fiber-optic information distribution including electro-optic interfaces, sensor networks and sensor fusion, secure high-bandwidth communication links; and
- optical data processing, including holographic neural networks, nonlinear optics research and experimentation and image processing.

**Sales Volume:** \$30 million

**No. of Employees:** 200

**Key Customers:** Canada: Atmospheric Environmental Service, Canadair, Canada Centre for Remote Sensing, Hydro Québec, RCMP, Teleglobe

U.S.: AT&T, Hughes Aircraft Co., Jet Propulsion Lab, Los Alamos National Lab, NASA, TRW, USAF

Europe: British Telecom, Marconi Avionics, France Telecom

Japan: Hitachi, Kawasaki, Nissin Steel, Sony, Toshiba

### **Company Background**

MPB Technologies Inc. began operations in January 1977 as a spin-off from the research laboratories of RCA Canada. The company is divided into six technologically oriented divisions: Communications, Electromagnetics, Fusion Technology, Lasers & Electro-Optics, Space & Photonics and Telerobotics.

MPB Technologies' products are sold worldwide, with more than 70% of its business originating from outside Canada. The company designed and manufactured the world's first undersea branching multiplexers, which were put into operation in 1992 in the optical fiber Trans Atlantic Telecommunications System TAT-9.

MPB Technologies has won a number of national and provincial awards: Canada Awards for Business Excellence - Innovation 1990 and Entrepreneurship 1990 (Industry, Science and Technology Canada); Canada Export Award 1990 (External Affairs and International Trade Canada); Prix MICA - Export 1990 and Business of the Year 1990 (Conseil de l'industrie électronique du Québec); Mercuriades - Business of the Year 1992 and Research & Development 1992 (Quebec Chamber of Commerce).

## **MPR TELTECH LTD.**

8999 Nelson Way  
BURNABY BC V5A 4B5  
CANADA

Tel: (604) 294-1471  
Fax: (604) 293-5787

Contact: Cameron Young, Business Development Manager

### **Nature of Business**

MPR Teltech Ltd. is an advanced telecommunications company providing design, consulting, product development and integration services.

### **Products/Services**

The following examples show the scope of MPR Teltech's capabilities in photonics:

- design, manufacture and installation of a fiber-optic-based premium video conferencing and corporate TV system, which has been deployed by BC TEL on a commercial basis, making it the first telco in North America with an in-service broadband portfolio;
- development of a fiber-optic-based fiber-to-the-curb, video-on-demand system, which was deployed by Michigan Bell for an education application in the first true video dialtone trial in the U.S.;
- development of an infrared multi-point voice and data communication system for use in free space environments; and the
- development, manufacture and licensing of a leading edge ATM switch/mux technology for Newbridge Networks, incorporating a variety of fiber-optic and copper access modules for networking voice, video and data.



**Sales Volume:** \$62 million

**No. of Employees:** 500

**Key Customers:** BC TEL, Stentor, Ameritech, Dept. of National Defence, Dept. of Communications, Telecom Corporation of New Zealand, GTE Airfone, GTE communications Systems, and Newbridge Networks

### **Company Background**

MPR Teltech has over 40 years of product development and system engineering background in voice, video and data communications transmission networks. The company's broad technology base provides a total vertical capability to design and develop new services, and technologies as well as hardware and software products at all levels from components to integrated telecommunications systems. Established in 1979 by amalgamating the research and development divisions of Lenkurt Electric (Canada) Ltd. and Automatic Electric (Canada) Ltd., MPR Teltech, which is owned by BC TEL, has the largest R&D capability in western Canada.

MPR Teltech received the 1992 R&D 100 Award, which is presented annually by R&D Magazine to 100 of the year's most innovative scientific technologies. In 1991 and 1992, MPR received the Award of Excellence from the Electronics Manufacturers Association of B.C. for outstanding achievement in electronics innovation in B.C.

## MVS MODULAR VISION SYSTEMS INC.

3195 De Miniac  
ST. LAURENT QC H4S 1S9  
CANADA

Tel: (514) 333-0140  
Fax: (514) 333-8636

Contact: Peter J. Walker, CEO

### Nature of Business

MVS Modular Vision Systems develops, manufactures and markets world-class vision systems for welding, rail inspection and computer chip inspection based on its unique LaserVision Technology, which uses structured light sensors.

### Products/Services

MVS manufactures a family of machine vision products based on the LaserVision high-speed image processor technology. These include:

- *the LaserVision Image Processor*, a high-performance image processor for structured light sensors capable of analyzing 14,400 surface coordinates per second;
- *the LaserVision Sensor*, a special sensor for hostile working environments (i.e. welding), developed in cooperation with the National Research Council Canada;
- *the LaserVision QFP Scanner*, a leading-edge inspection system developed in cooperation with IBM Canada to inspect computer chips. The leads on each chip are inspected for shape, angle, spacing, overall geometry and coplanarity;
- *the LaserVision Rail Inspection Systems*, which has two lasers and sensors integrated with the LaserVision Image Processor to inspect rail, including gauging, profiling and classification of rail; and
- *the LaserVision Tracking and Welding Control*, which involves the integration of the LaserVision Image Processor and Sensor for robotic guidance and automated welding. The MVS sensors are the smallest and fastest, and can operate in hostile welding environments without maintenance for over 200 hours.

**Sales Volume:** \$2 million

**No. of Employees:** 26

**Key Customers:** Allied Signal Aerospace, ASTECH/MCI, Babcock & Wilcox, Bradford-White, CN Rail, CP Rail, FIAT, IBM, Ontario Hydro, Pratt & Whitney, Rockwell Aerospace, and Ferranti Sciaky

### **Company Background**

MVS was founded in 1985 to exploit its LaserVision technology for the guidance and control of welding robots and other niche machine-vision markets. MVS then expanded to three-axis Cartesian robots for welding water heating tanks, pipes, aircraft parts, etc. and applied vision to many inspection applications.

MVS's major achievements include the development of welding systems capable of tracking tight butt joints, systems capable of high-precision tracking, systems for high-speed rail inspection, computer chip inspection systems with an accuracy of 2 microns, and welding systems that operate in hostile welding environments.

MVS uses direct sales, distributors, business partners and systems integrators to develop machine vision applications that be converted into vision products. At present, MVS has collaboration arrangements with FASE SpA, Babcock & Wilcox and Nichols Research.

## **NEWNES MACHINE LTD.**

P.O. Box #8  
SALMON ARM BC V1E 4N2  
CANADA

Tel: (604) 832-7716  
Fax: (604) 832-9810

Contact: Bill Newnes, President

### **Nature of Business**

Newnes Machine Ltd. is a forest products processing machinery company.

### **Products/Services**

Through its Newnes Automation division, the company provides a complete line of photonics sensors and optimisers for softwood sawmills:

- laser based thickness and profile sensors;
- optical and laser-based processing optimization systems for log bucking, primary breakdown, and edging/trimming/sorting operations;
- optimization software.

**Sales Volume:** \$50+ million

**No. of Employees:** 350

**Key Customers:** Customers include major forest products manufacturers in Canada and the U.S.

### **Company Background**

Founded in 1912, the company has built a reputation on the design and manufacture of processing equipment for softwood sawmills. The innovative integration of photonics in their processing equipment has lead to the company's rapid growth.

The company operates from offices in Salmon Arm, B.C., and Columbus, Ohio. Newnes optimization photonics are based on a flexible modular design that allows step-by-step expansion toward total mill optimization systems. The company operates training facilities in Salmon Arm and Columbus and service centres in B.C., Ohio, Georgia and Oregon.

## **NORTHERN TELECOM LTD.**

Divisions and contacts for photonics:

Optical Cable Plant  
1370 Fletcher Road, P. O. Box 807  
SASKATOON SK S7K 3L7  
CANADA

Tel: (306) 384-5100  
Fax: (306) 384-5452

Contact: R. S. Lowe, Plant Manager

Outside Plant Division  
105 Laurentien Blvd.  
ST. LAURENT QC H4N 2M3  
CANADA

Tel: (514) 747-5551  
Fax: (514) 744-8838

Contact: P. Camet, Plant Manager

Transmission Networks Division  
9300 Trans Canada Hwy  
ST. LAURENT QC H3C 3J8  
CANADA

Tel: (514) 956-1010  
Fax: (514) 956-3362

Contact: M. Unger, Division General Manager

### **Nature of Business**

Northern Telecom (NT) is a global telecommunications company which designs, manufactures and supplies a complete line of fully digital switching and transmission systems for public and private communications network.

### **Products/Services**

Products include data communications networks, fibre optic equipment, telephones, outside plant hardware, radio and microwave, undersea systems as well as network integration services.

Canadian photonics products constitute about five percent of its sales, and include the following: optical fibre and cables, connectors and patch cords, installation equipment such as

splicer, splice closures, field test equipment, and termination boxes, high speed digital transmission equipment which contains laser diodes manufactured by Northern Telecom.

**Sales Volume:** \$10 billion

**No. of Employees:** Company total 58,000

**Key Customers:** Telephone operating companies, inter-exchange carriers, corporations, universities and other institutions world wide.

### **Company Background**

Northern Telecom Ltd. is the leading global supplier of fully digital telecommunications switching systems. NT is 52.4% owned by BCE Inc. It employs 58,000 people and operates in more than 90 countries worldwide. 52 manufacturing plants are located in nine countries. Research and development are conducted by Bell-Northern Research, a subsidiary that operates facilities in six locations with additional R&D performed at 22 NT manufacturing facilities.

## OPTECH INC.

100 Wildcat Road  
NORTH YORK ON M3J 2Z9  
CANADA

Tel: (416) 661-5904

Fax: (416) 661-4168

Contact: S. Sizgoric, Vice President, Business Development

### Nature of Business

Optech Inc. is a systems house specializing in laser radar applications, with a focus on custom application development and R&D.

### Products/Services

Optech Inc.'s primary business is custom development. Products developed by it are manufactured by a sister company, Optech Systems Corporation, including:

- *the Model 1020 Airborne Laser Terrain Mapping System*, an integrated system for digital capture of airborne data for the efficient generation of digital terrain maps;
- *the Model 501SA/SB Laser Rangefinder*, a high-resolution instrument that measures the distance to almost any surface, with application for altimetry information in airport flight inspection systems, for terrain and ice ridge profiles in aerial survey sensing, tree height measurements for forest inventories, etc.;
- *the Model G150 Laser Rangefinder*, a more compact unit for ground-based use in mining, geophysical survey and environmental applications. Other potential applications include robotic guidance, automobile collision warning sensor, bin level indicator, airport docking sensor, etc.;
- *the Wideband logarithmic amplifiers* for radars, lidars and rangefinder systems; and
- *the Cavity Monitoring System (CMS)*, which was co-developed with Noranda Technology Centre to make remote non-contact single-point measurements of areas that are hazardous or inaccessible to mine personnel.



**Sales Volume:** \$6 million

**No. of Employees:** 60

**Key Customers:** Dept. of National Defence, Environment Canada, Energy, Mines and Resources, Canadian Hydrographic Service, U.S. Dept. of Defence, U.S. Army Corps of Engineers, Swedish Dept. of Defence, LTV Sierra, Saab Instruments, Noranda, Inco.

### **Company Background**

Established in 1974, Optech Inc. has a long history of technological innovations. Its airborne scanning lidar bathymeter system produced data for the world's first nautical chart based on lidar data. This capability is currently being offered in a fourth-generation system-SHOALS. Optech's experience with high-accuracy rangefinders has evolved into a 3-D spatial position measurement capability, by combining scanning with rangefinding. This capability is now used from airborne topographic mapping (Model 1020) to robotic vision applications in the Canadian Space Program.

Optech's differential absorption lidar systems are capable of providing remote concentration measurement of a wide range of atmospheric pollutant and trace gases, as well as of gas-pipeline leak detection from airborne platforms. Other systems provide the capability to measure remotely the opacity of industrial plumes.

## OPTO-ELECTRONICS INCORPORATED

2538 Speers Road, Unit # 9  
OAKVILLE ON L6L 5K9  
CANADA

Tel: (416) 827-6214  
Fax: (416) 827-6216

Contact: Brian K. Garside, President

### Nature of Business

Opto-Electronics Inc. is a major supplier throughout the world of high speed fiber-optic test and measurement instrumentation.

### Products/Services

Opto-Electronics' product line is based on the ability to generate and detect picosecond time-scale optical pulses. Major markets are in the characterization of short-haul optical-fiber local-area communications, multi-sensor networks and fiber-optic component analysis. Its products include:

- *the Millimeter Resolution OTDR (Reflection Mode)*, which is available with a wide range of options at wavelengths from 0.68 to 1.55 microns as plug in units to a rack-mountable mainframe system;
- *the Fiber Bandwidth Measurement Instruments*, which is especially suitable for high speed data links and local area networks at 0.85 microns and 1.3 microns;
- *the Fiber Cable Strain Measurement Instrument*, which is based on the millimeter resolution OTDR instrumentation, specialized for the measurement of strain in fiber cables;
- *the Photon Counting OTDR System*, which has a 30db increase in sensitivity that has enabled the detection of Rayleigh backscattering from optical fibers with an unprecedented cm-scale resolution; and
- *the Portable Optical Fiber Monitors*, which are completely self-contained field portable Fresnel reflection and backscatter OTDRs for short-haul applications having zero deadzone and distance resolution measured on a millimeter scale.

**Sales Volume:** In the region of \$2 million.

**No. of Employees:** 20

**Key Customers:** Telecommunications: AT&T, Corning and Siecor  
Aerospace: McDonnell Douglas, Boeing and Lockheed  
Military: Martin Marietta, Hercules and Hughes  
European and Far Eastern PTTs, high technology manufacturers and national research institutes

### **Company Background**

Opto-Electronics Inc. is the original manufacturer of the world's fastest picosecond/gigahertz photodetectors and diode laser light sources. Established in 1976, the company has become one of the leading fiber-optic test and measurement instrument manufacturers in the world.

Opto-Electronics' first product, the PD-10 picosecond photodetector, was introduced in 1979. This detector was the fastest commercially available device at that time and was the forerunner of an ever expanding line of fiber-optic test and measurement instrumentation, ranging from ultrafast fibre-optic receivers and transmitters, to signal processing instruments and systems, such as the unique millimeter resolution OTDR and the multi-gigahertz Bandwidth Tester.

The Opto-Electronics Millimeter Resolution OTDR (Optical Time Domain Reflectometer) was a recipient of the 1988 Photonics Circle of Excellence Award. The TDR30 photon-counting high-resolution OTDR system was similarly honoured in 1990 by the Photonics Magazine.

## **OPTOTEK LTD.**

62 Steacie Drive  
KANATA ON K2K 2A9  
CANADA

Tel: (613) 591-0336  
Fax: (613) 591-0584

Contacts: David Kennedy, President  
Gunnar Wareberg, Vice-President, Operations

### **Nature of Business**

Optotek designs and manufactures optoelectronic semiconductor components, subsystems and related software products for military and industrial applications.

### **Products/Services**

Optotek produces customized LED displays, LED print heads, associated drive electronics subsystems and display test equipment. Key optoelectronic products include:

- LED recording head displays for reconnaissance cameras for the U.S. Navy as used in Desert Storm operations;
- the world's most sophisticated LED print head for use in electronic printing presses;
- customized LED displays for visual applications: bargraphs, range readouts, stand-by sights, aiming reticles, interactive switches; and
- customized LED displays for photo exposure applications: microfiche annotation, movie film editors, image generators, computer printers.

Optotek also designs and manufactures application-specific gallium arsenide field-effect transistors and monolithic microwave integrated circuits (MMICs) for military and communications requirements, as well as high-resolution microwave integrated circuits. The Company has commercialized computer-aided engineering software products, MMICAD<sup>TM</sup> and Honeycomb<sup>TM</sup>.

**Sales Volume:** \$2 to \$3 million range

**No. of Employees:** 25

**Key Customers:** AM International, Chicago Aerial Industries, Eastman Kodak, Fairchild Space & Defense, Hitachi, Israel Aircraft Industries, Kollsman, M/A-Com, Motorola, Sanyo, Spar Aerospace, Toshiba, TTriQuint, U.S. Army, and the U.S. Navy

### **Company Background**

Optotek was founded in 1977. It has a modern 36,000 sq. ft. plant, which features a full complement of optoelectronic semiconductor processing and test equipment, as well as Class 100 and Class 1000 clean rooms.

Optotek's products are supported through a combination of local representation and direct engineering sales support from their home office. It has representatives in the U.K., France, Germany, Italy, Israel, Japan and most of the U.S.

## **OZ OPTICS LTD.**

2-244 Westbrook Road  
West Carleton Industrial Park  
CARP ON K0A 1L0  
CANADA

Tel: (613) 831-0981  
Fax: (613) 836-5089

Contacts: O. Sezerman, President  
G. D. Best, Project Manager

### **Nature of Business**

OZ Optics develops and manufactures fiber-optic components for use in telecommunications, industrial, military and medical fields. The company also sells a fiber-optic educational kit for training purposes.

### **Products/Services**

OZ Optics develops and manufactures the following components: low/high power laser-fiber couplers, fiber-optic educational kits, collimators, line/cross target makers, variable/fixed attenuators, polarization rotators, polarizers, wavelength-division multiplexers, polarization maintaining connectors and coupler, laser-diode-to-fiber couplers, laser-diode collimators, laser-diode power combiners, fiber-optic reflectors, fault locators, fiber-to-photodiode couplers, fiber-pigtailed isolators and universal connectors.

**Sales Volume:** \$2-5 million

**No. of Employees:** 15-25

**Key Customers:** Major industries in the areas of telecommunication, local area networks, medical and military applications, and educational institutions. The products are sold worldwide.

### **Company Background**

OZ Optics was founded in 1985 to develop fiber-optics components for interferometric sensors and for the telecommunications. The product line was expanded to 25 within the initial six years. OZ Optics' patented high-precision alignment technique enables the company to manufacture different fiber-optic components at low cost while maintaining an excellent standard of quality.

## **PHILLIPS-FITEL INC.**

300 Consillium Place, Bureau 200  
SCARBOROUGH ON M1H 3G2  
CANADA

Tel: (416) 296-0250  
Fax: (416) 296-0743

Contacts: J. W. Barney, President  
K. Yoshida, VP Technology

### **Nature of Business**

Phillips-FITEL Inc. manufactures OPGW (optical ground wire) for electric power companies. It is also a supplier for installation accessories and equipment specifically for the power utility market.

### **Products/Services**

*OPGW* is an optical fiber cable surrounded by aluminum-cladded steel wires. It has a dual role as a ground wire to protect overhead transmission lines and a telecommunication transmission cable. Dispersion-shifted fibers for the operation at 1550 nm are used for most of the products.



**Sales Volume:** \$10-20 million.

**No. of Employees:** 20-50

**Key Customers:** Electric power companies such as Hydro Quebec.

**Company Background**

Phillips-Fitel Inc. was incorporated in 1992 as a joint venture between Phillips Cables Ltd. and Furukawa Electric Co. Ltd. The factory, which is located in Rimouski, Quebec, became operational in January 1993. Initially, Hydro Quebec was the main user of the OPGW. However, aggressive marketing effort is currently taking place in order to broaden the market not only in North America but overseas as well. The technology basis from Japan combined with the local aluminum supply and market in Quebec are the key elements of the business.

## PHOTON SYSTEMS CORP.

7725 Loughheed Highway  
BURNABY BC V5A 4V8  
CANADA

Tel: (604) 420-8733  
Fax: (604) 420-9606

Contacts: John Maycock, President  
C.J. Chung, Project Manager, Digital Systems

### Nature of Business

Photon Systems Corp. designs, manufactures and installs fiber-optic communications systems and provides supporting systems integration services.

### Products/Services

Photon's products and services include:

- *analog AM fiber-optic transmission systems* for transporting up to 80 video channels over single-mode fiber;
- *digital video transmission systems* for cable TV and broadcast applications using high-speed digital and hybrid analog techniques;
- *installation hardware and accessories*, including splice cases and trays, couplers and splitters, fusion splicers, cleavers and restoration kits;
- *fiber-optic cable* with designs that include outdoor plant cables for aerial, duct or buried installation and indoor cables;
- *UHF to VHF block downconverters* to convert any block of channels from UHF to VHF for distribution on cable;
- *test equipment* needed to test and maintain fiber-optic systems, including power meters, laser sources, OTDRs and fault locators; and
- *fiber-optic system design software modules* to help customers plan cost-effective, future-oriented systems.

**Sales Volume:** In the \$2 to \$3 million range

**No. of Employees:** 10

**Key Customers:** Cable television and telephone companies in North America, Australia, Asia, Latin America and South America. Universities, airports and organizations with high-security requirements.

### **Company Background**

Photon Systems Corp. was formed by the Nexus Group of Companies in 1991 as an incubator company specializing in fiber optics. In 1993, Photon became privately held when Nexus sold its share in Photon, but there is still a close association between Photon Systems and many of the Nexus companies.

Photon Systems' engineers have more than fifteen years' experience in the design, supply and installation of fiber-optic communications systems. The company has patents on an optical fiber cable monitoring system for locating faults, degradation or intrusion, and patents pending in several areas, such as an innovative optical receiver for cable television applications. Photon Systems' growth at a rate of 100% each year is fuelled by the ongoing introduction of new products based on the latest advances in video transmission technology.

Photon Systems manufactures fiber-optic video transmitters and receivers. In support of these products, Photon provides systems integration services and distributes a complete line of fiber-optic supplies.

Photon Systems sells directly to customers in western Canada and Latin/South America. It also works with local distributors in other areas.

## **POCATEC LTD.**

85, route 132 Ouest  
LA POCATIERE QC G0R 1Z0  
CANADA

Tel: (418) 856-1454

Fax: (418) 856-5978

Contacts: J. Landry, General Manager  
C. Cassista, R&D Manager

### **Nature of Business**

Pocatec designs, manufactures and markets industrial electronics products.

### **Products/Services**

These products are:

- mass-transit communications systems
- traffic-light control systems
- digital speedometers
- fiber-optics education kits

The products are being used in more than 25 countries worldwide.

**Sales Volume:** \$1-5 million

**No. of Employees:** 11-50

**Key Customers:** Bombardier, Via Rail, Prevost Car, Hydro Quebec, Quebec Transportation Department, City of Montreal, Mexico City Metro, and New York City Metro

**Company Background**

Founded in 1974, Pocatec Ltd. has introduced many high technology products in the electronics field as a result of an aggressive R&D program. The manufacturing plant is equipped with the state of the art facilities including the SMT assembly line. Pocatec has established a reputation as a high quality supplier.

## **PORTER ENGINEERING LTD.**

5800 Cedarbridge Way  
RICHMOND BC V6X 2A7  
CANADA

Tel: (604) 273-1868

Fax: (604) 273-6635

Contacts: Dan Smith, President  
John Wilby, Sales Manager

### **Nature of Business**

Porter Engineering is a leader in the development of photonics-based scanning devices for forest industry process control applications.

### **Products/Services**

The company's products include:

- Optimization software ("RT<sup>2</sup>, Real Time for Real Trees");
- tree length log bucking, scanning, optimization and process control (including log bucking scanners, log sorting CANSCAN system, light curtain scanners, panelboard defect vision system);
- primary log breakdown optimization for sharp-chains, end doggers, reducer bandsaws, and Chip-n-Saws;
- food industry can scanning systems.

**Sales Volume:** \$5 million

**No. of Employees:** 23

<b>Key Customers:</b>	Canadian Forest Products	Plum Creek
	Champion International	Pope & Talbot
	Crestbrook	Repap
	Interfor	West Fraser
	Lignum	Weyerhaeuser
	MacMillan Bloedel	

### **Company Background**

Established in 1971 by Dr. Andy Porter, the company initially provided specialized equipment engineering services to forest industry clients. Electronic and photonic process control of primary breakdown lines became an increasingly important part of the products and services provided over time.

Today the company has evolved into a leader in the supply of log scanning and optimization equipment for softwood sawmills. It is estimated that over 70% of logs processed in Western Canada are scanned with a Porter system. The company's key markets are in Canada, Australia, New Zealand and the U.S. Pacific NorthWest. Recently the company has expanded its market presence to the southern U.S. with sales to Weyerhaeuser and Champion International.

## POWERLASERS INC.

564 Weber St. N., Unit #10  
WATERLOO ON N2L 5C6  
CANADA

Tel: (519) 746-8194  
Fax: (519) 746-7061

Contacts: W. W. Duley, President  
M. Ogmen, Managing Director

### Nature of Business

Powerlasers Inc. is involved in the production of custom-designed industrial laser processing systems especially suited to laser process aluminum and copper.

### Products/Services

Powerlasers' products/services span the following areas:

- "Weld-Al", a patented laser welding head for laser welding of aluminum alloys;
- "Weld-Cu", a welding head for laser welding of copper;
- custom-designed industrial laser processing systems; and
- contract R&D.

Due to contents of alloy compositions, some aluminum alloys are impossible to laser weld. Alloys that contain magnesium are the most problematic. Differences between the thermal properties of magnesium and aluminum cause welds to be brittle and porous. Unfortunately, the lightest and the strongest alloy (7000 series) and the automotive alloy (5754) have this problem. For the first time, Powerlasers has developed and patented a new laser technology which produces excellent quality laser welds on these and other aluminum alloys. These results have been extensively tested by Alcan, GM Canada and Utilase (Detroit). Based on this technology, Powerlasers has developed specialized "welding heads" that permit consistently high quality welded joints in aluminum and copper.



**Sales Volume:** In the \$1 to \$3 million range

**No. of Employees:** 10

**Key Customers:** General Motors, Siemens, Energy, Mines and Resources Canada, Alcan and Endacom 2000 Inc.

### **Company Background**

Since 1976, Powerlasers Inc. has been active in working with industry to implement the latest in innovative laser technology. Its activities range from the design of laser drilling systems for the tobacco industry to microelectronics and, lately, to ophthalmologic diagnostic systems. Some of the solutions developed during this period are now commonplace techniques in diverse industries. Current company focus is on the laser processing of high reflective metals, such as aluminum and copper.

Powerlasers is currently under contract to develop a flexible laser robotics manufacturing cell for General Motors of Canada. This unique system incorporates a high power CO<sub>2</sub> laser, a 5-axis robot and an automated cutting head. This unique system will allow the user to switch between welding, cutting, drilling or heat treating applications within minutes. Powerlasers will install this manufacturing cell in a GM prototyping plant, where rapid application changes are necessary.

Powerlasers recently developed a new technique for laser regeneration of catalysts used during the petroleum refining process. This highly promising technique will allow the petroleum refining industry to regenerate catalysts on site. Furthermore, the process produces higher quality regenerated catalysts, as well as increased recycling.

Powerlasers has a new solid state imaging, integrating detector for ultra-violet wavelengths. In contrast to other available detectors in the market, the response of this new device increases with decreasing wavelengths. Furthermore, it is visible "blind" and does not require power during the detection/integration period. It is expected that this device will find applications in UV astronomy, UV laser eye surgery and other fields.

## **SEASTAR OPTICS INC.**

P.O. Box 2219  
2045 Mills Road  
SIDNEY BC V8L 3S8  
CANADA

Tel: (604) 656-0891  
Fax: (604) 655-3435

Contacts: Peter Berrang, President  
Kathy Neeves, Manager - Administration

### **Nature of Business**

Seastar Optics specializes in connecting laser diodes to optical fibers and in producing bench-top instrumentation for controlling laser optics for use in fiber-optic communications, optical sensing and for research.

### **Products/Services**

Seastar Optics' products include:

- a line of multi-mode, single-mode, polarization preserving and optically isolated pigtailed laser diodes, temperature-controlled pigtailed laser diodes;
- 100 kHz to 3.0 GHz, 830 nm analog laser diode module;
- Type FC, ST and SC single-mode and multi-mode connectorized laser diodes;
- collimated laser diodes;
- thermoelectric controllers; and
- low cost laser diode driver, ultra-stable laser diode driver, modular laser driver, and high power TEC controller /driver.

**Sales Volume:** \$4.5 million

**No. of Employees:** 33

**Key Customers:** Fortune 500 companies, military groups, large telecommunications and R&D organizations

### **Company Background**

Seastar Optics, which is a member of the Axys Group of companies, was formed in 1984 to develop novel fiber-optic sensors. The Axys Group, started in 1974, is involved in a number of high technology businesses. It has offices in Sidney, Nova Scotia and Vancouver, B.C.

Seastar was the first company to market an ultra-low noise laser diode driver. This product is now in commercial production, as are a number of associated laser diode control products.

Seastar was also the first firm to introduce a single-mode fiber type "ST" optical connectorized laser diode for mass market optical communications applications. This line has expanded to include the key world standard connectors, such as FC and SC connectors. Seastar's latest innovation, very high-efficiency coupling from laser diodes into optical fibers, is in commercial production. Seastar is developing various fiber laser devices.

Seastar's products are distributed through agents in a number of countries.

## **SENSOR ADAPTIVE MACHINES INCORPORATED**

6360 Hawthorne Drive  
WINDSOR ON NT8 1J9  
CANADA

Tel: (519) 944-6641  
Fax: (519) 944-1928

Contact: Tim Pryor, President

### **Nature of Business**

Sensor Adaptive Machines Incorporated (SAMI) is engaged in the production of electro-optical and machine vision-based measuring systems for the inspection of parts in the automotive and aerospace businesses and in the development of new sensor systems for the control of machine tools and robots in those businesses.

### **Products/Services**

The main photonics-related products and services provided by SAMI are sensor units that utilize CCD camera chips (both linear and matrix arrays) and laser diodes or light emitting diodes.

**Sales Volume:** \$2 million

**No. of Employees:** 15

**Key Customers:** General Motors, Pratt & Whitney, Ford Motor Co., Eaton, KYB, Canadian Space Agency, Chrysler Corporation, General Electric, U.S. National Center for Manufacturing Sciences

### **Company Background**

SAMI is affiliated with Diffracto Ltd. The company has a very large technology position in the use of photonics for the inspection and measurement of manufactured parts, and the control of processes therewith. The company has well over 100 U.S. patents, as well as numerous foreign patents and pending patent applications in this field.

SAMI has been in existence since 1988 with the objective of combining machine vision and electro-optical sensing with the advanced machine controls, such as the Next Generation Controller. It is heavily engaged in development efforts with General Motors, Hughes Aircraft and others under the G.M. Intelligent Lathe Project, for which SAMI is the prime contractor. The company is also engaged with the Canadian Space Agency and General Motors to develop a spinoff from the "CanadArm" Guidance System usable for the assembly of cars for highly flexible niche market applications.

## **SERVO-ROBOT INC.**

1380 Graham Bell Street  
BOUCHERVILLE QC J4B 6H5  
CANADA

Tel: (514) 655-4223  
Fax: (514) 655-4963

Contact: Jean-Paul Boillot, President

### **Nature of Business**

Servo-Robot develops and manufactures a full line of products and systems for process control and industrial automation.

### **Products/Services**

Servo-Robot's vision systems are used for factory automation, inspection, 3D digitization, autonomous robotics, information technology, 3D imaging sciences and medical data acquisition. Each system includes a laser scanning camera and a powerful control and multi-processing unit, supported by a series of modular software packages generally programmed via a compatible PC and designed for a variety of applications, such as automated seam tracking, surface digitization and dimensional measurements.

A unique auto-synchronized 3D laser scanning technology is used in compact high-precision 3D camera systems featuring high-speed image acquisition.

Servo-Robot's products include SPOT and BIP miniature 3D laser cameras that can detect a few microns to measure, digitize and track and are small enough to easily fit on the wrist of a robot. The JUPITER compact 3D laser camera can generate images of objects up to the size of a human being at a distance of a few meters.

**Sales Volume:** In the \$2 to 5 million range

**No. of Employees:** 30

**Key Customers:** Matsushita, Daihen, Amada, Yaskawa, Nissan, Hyundai, IGM  
Robotersystem, Institut de Soudure, Mécanique Creusot-Loire, CP Rail,  
Hydro-Québec

### **Company Background**

Servo-Robot was established in 1983 to supply high-quality 3D laser scanning vision systems for process control and factory automation, and is now recognized as a world leader in the field.

Servo-Robot's success is closely linked to the development and implementation of industrially reliable optoelectronic technology by its team of engineers and scientists. Servo-Robot collaborates closely with universities and with the National Research Council of Canada. It also cooperates with multinational companies for the integration of its optoelectronic technology in their product lines.

Servo-Robot has a network of distributors' agents covering many western European and East Asian countries, and is planning to establish joint ventures in the U.S. and Japan.

## **SOFTAC SYSTEMS LTD.**

3046 Westwood Street  
PORT COQUITLAM BC V3C 3L7  
CANADA

Tel: (604) 464-8505  
Fax: (604) 464-2242

Contacts: Warren Thomlinson, President  
Ian Bowman, General Manager

### **Nature of Business**

SOFTAC is a systems engineering house specializing in the manufacture of machine control and industrial drive systems for sawmills, veneer peeling lines, ski lifts and crane hoists.

### **Products/Services**

The company has expertise in the development and manufacture of laser and camera-based vision scanning systems and robotics controls. SOFTAC manufactures complete carriage networks for headrigs and cant, edger and trimmer optimization systems. Its photonics-based equipment includes the following:

- TOP GUN camera-based vision scanner system used for log profile scanning, quality control and sorting and associated "Log-Calc" networks/headrig, camera-based, primary breakdown optimization system;
- Edger and Trimmer Optimization System, a laser-based profile scanning system that reads thickness profiles 500 times per second with a thickness accuracy of 0.015 inches;
- Currently under commercial development is the BIRIS scanner, a camera-based 3-D scanner developed by the NRC and now under license to SOFTAC for wood products industry applications such as true-shape log measurement and woods mensuration;
- New product research & development includes a vision-system-guided hydraulically powered manipulator.



**Sales Volume:** \$3+ million

**No. of Employees:** 23

**Key Customers:** Customers include major forest products equipment manufacturers such as: Kockums Cancar, Optimil Machinery, Flare Machinery

Major forest products manufacturer clients include: Canfor, Crestbrook Lumber, Champion International, CIP, Doman Forest Products, Dunkley Lumber, Interfor, Louisiana Pacific Corporation, MacMillan Bloedel, Normick Perron, Northwood Pulp & Paper, Riverside Forest Products, S & R Forest Products, Weldwood of Canada

In addition to North American markets, the company's products have been installed in China, Australia, New Zealand, and Europe.

### **Company Background**

SOFTAC emerged from the early 1970's as a manufacturer of machine control and industrial drive systems. Continuation of this development lead to digital and microprocessor based technologies and eventually to the development of laser and camera based scanning systems and integrated lumber recovery/optimization systems.

The company maintains subsidiary offices for SOFTAC INC. in Albertville, Alabama and Ferndale, Washington.

## **THE OPTIKON CORPORATION LTD.**

410 Conestogo Road  
WATERLOO ON N2L 4E2  
CANADA

Tel: (519) 885-2551  
Fax: (519) 885-4712

Contacts: Minas Vassiliadis, President  
Steve Daicos, Sales Manager

### **Nature of Business**

The OPTIKON Corporation is a photonics systems integration, manufacturing, sales and marketing organization for optical, electro-optical, optoelectronic and optomechanical systems and components.

### **Products/Services**

OPTIKON manufactures the following proprietary products:

- PAL line of very high illuminance light sources for high speed image recording and analysis;
- A-BLAST, an automated air bag lot assessment static test system; and
- the cal-LIGHT 400, a calibrated precision lightmeter.

In addition, OPTIKON provides a systems integration of manufactured photonic products which requires additional supporting instrumentation to meet customer needs. This is offered solely for products sold separately by OPTIKON. It also distributes highly specialized photonic and closely related products which are manufactured outside Canada and which require technical know-how to be marketed.

OPTIKON provides technical services, including installation, repairs and calibration for all of its products.

**Sales Volume:** \$5 to \$10 million

**No. of Employees:** 22

**Key Customers:** Widely based in electronics, automotive, telecommunications, automation, R&D, defence, etc.

### **Company Background**

The OPTIKON Corporation was established in 1974 to offer specialized marketing services for photonic products in Canada, the U.S. and overseas. As the company evolved, it specialized in the following niche areas: visible and infrared light measuring instrumentation, fiber-optic test and measuring instrumentation, optical R&D laboratory hardware and non-contact optical measuring and monitoring instrumentation. In 1987, through an acquisition, OPTIKON expanded into the field of high speed image recording and analysis, thus capturing a sizeable market share of the Canadian market, as well as expanding into the U.S., European and Japanese markets.

## **UNITED INDUSTRIAL PRODUCTS/FORESTLINE ELECTRONIC PRODUCTS LTD.**

1095 Churchill Crescent  
NORTH VANCOUVER BC V7P 1P9  
CANADA

Tel: (604) 985-6161  
(B.C.) 1-800-663-4225  
Fax: (604) 985-3030

Contacts: Stuart Moore, President  
Joe Hailey, Manager

### **Nature of Business**

UIP/FORESTLINE is manufacturer of photonics-based process and quality control systems for the forest products industry.

### **PRODUCTS/SERVICES**

UIP/FORESTLINE offers a wide range of quality control equipment for the forest products industry including:

- high-speed optical grade mark readers for planer mills and sawmills utilizing various grade mark configurations-DATASCAN (1 mark), ACTISCAN (2 marks), ACTISCAN 2 (25 marks), INTELLESCAN (unlimited # of grade marks);
- ALGIS automatic lumber grading system;
- OPTISCAN trimmer optimiser system;
- log deck scanning system;
- lasers for edge and trim guides, mill monitoring equipment.

**Sales Volume:** \$2 million

**No. of Employees:** 12

**Key Customers:** UIP sells its line of electronic and photonics products, "Forestline", to softwood lumber, panelboard and pulp & paper forest products producers across North America including: Boise Cascade, Canadian Forest Products Ltd., Crestbrook, Doman Forest Products, Fletcher Challenge, Interfor, MacMillan Bloedel, Pope & Talbot, Riverside Forest Products, Slocan Forest Products, Tolko, Weldwood, West Fraser, Weyerhaeuser

### **Company Background**

The company was founded in 1977 as a supplier of electronic based monitoring and quality control equipment for the solid wood, panelboard, and pulp & paper processing industries.

The company's research activities have lead them to develop several laser and optical photonics based systems for grade reading, trimmer optimization, and board profiling applications.

Most recently UIP has developed ALGIS, an automatic lumber grading and inspection system, the first of its kind in North America. ALGIS is a modular vision system that analyses four sides of a piece of lumber for shape and defects and grades it. The system can grade over 2000 boards per minute, more than twice the current manual rate. There are over 7300 sawmills world wide that could benefit from this technology.

## **VISIONSMART**

5807 - 104th Street  
EDMONTON AB T6H 2K4  
CANADA

Tel: (403) 435-7082  
Fax: (403) 436-0963

Contact: Daniel Kenway, President

### **Nature of Business**

VisionSmart develops and manufactures photonics equipment used for quality control and precision processing applications for lumber, food and coin products.

### **Products/Services**

The company has special capabilities in multi-sensor integration for grading or quality control processes and with systems requiring massive computer processing speeds using parallel processing.

- visual inspection systems for lumber grading, egg grading and coin blank quality control using single and multiple sensors, and sensor types (e.g. visual/X-ray);
- camera-based bucking and canter optimisers, and X-ray-based edger optimiser for softwood processing;
- 3-D log scanning device utilizing the compact BIRIS technology.

**Sales Volume:** \$1 to \$3 million

**No. of Employees:** 10

**Key Customers:** Lignum Ltd.  
Sherritt Gordon  
Buchanan Lumber  
Villetard Eggs

### **Company Background**

Founded in 1987 the company has built a reputation on the design and manufacture of optical inspection systems for lumber, eggs, and coins as well as process optimization systems for softwood manufacturers.

More recently the company has entered into a licensing agreement with MacMillan Bloedel Research to commercialize a X-ray edger optimiser. Also VisionSmart and SOFTAC Systems Ltd. of Port Coquitlam, B.C. have acquired a joint licence from the National Research Council to develop a compact 3-D log scanning device utilizing the unique BIRIS technology. Future projects include a National Mint numismatic quality control system.

## **VORTEK INDUSTRIES LTD.**

1820 Pandora Street  
VANCOUVER BC V5L 1M5  
CANADA

Tel: (604) 251-2451  
Fax: (604) 251-3356

Contacts: Reg Allen, President  
Gary Albach, Executive Vice-President

### **Nature of Business**

Vortek designs and manufactures the world's most powerful arc lamp systems for large-area lighting, industrial materials processing, high temperature aerospace testing and sunlight simulation.

### **Products/Services**

Vortek currently manufactures four models of lamp systems, ranging in power from 50 to 300 kw, together with standard optical reflectors. In addition, Vortek designs and manufactures custom optical reflectors required for specific applications. Vortek supplies its customers with full service support, including engineering design assistance and on-site training in the operation and maintenance of Vortek systems.

Vortek is expanding its products to include 600 kw and 1500 kw lamps, along with specialized lighting systems for mobile emergency response, industrial and entertainment lighting.



**Sales Volume:** Not available

**No. of Employees:** Not available

**Key Customers:** U.S. Air Force, U.S. Dept. of Energy, NASA, Boeing, Martin Marietta  
Through U.S. joint ventures: Motorola, Siemens, IBM, Telefunken,  
Honeywell, Hyundai, Harris, Philips, NTT, Tektronix

### **Company Background**

Vortek was founded in 1976 based on research at the University of British Columbia. Vortek is the exclusive licensee of patents granted on innovations for cooling arc lamps that allowed operation at high continuous powers, and has continued the technical development and marketing of powerful arc lamps.

In 1983, Vortek won the IR-100 Award for best new products worldwide. Since 1985, Vortek has been listed in the Guinness Book of Records under the category "Brightest Light".

Vortek maintains sales agents in Europe, Japan and North America. These representatives are supported by joint ventures in all geographic markets for technical market development of Whitelight™ products. The company maintains a customer applications laboratory in Vancouver for advanced process development.

## WATERLOO SCIENTIFIC INC.

419 Phillip Street, Unit 9  
WATERLOO ON N2L 3X2  
CANADA

Tel: (519) 746-6260  
Fax: (519) 746-8270

Contacts: C. J. Moore, VP Sales and Marketing  
J. Smith, VP R&D and Manufacturing

### Nature of Business

Waterloo Scientific Inc. develops and manufactures advanced test equipment for semiconductor and opto electronic materials. Waterloo Scientific also contract research work in a variety of areas.

### Products/Services

Waterloo Scientific's product line and typical applications include the following:

- *scanning photoluminescence mapping system*, which involves the testing and quality control of epitaxial layers, quantum well structures and compound semiconductor materials including epitaxial layer thickness mapping;
- *double crystal diffractometer mapping system*, which involves the testing and quality control of epitaxial layers, quantum well structures and compound semiconductor materials using x-ray methodology;
- *laser writer/laser pantography system*; capable of photo mask fabrications, micro machining, repair and modifications of LSI chips, and fabrications of OEIC (optoelectronic integrated circuit) by direct writing; and a
- *scanning laser microscope*, which conducts testing of detectors such as solar cell and infrared focal plane arrays.

**Sales Volume:** \$1-5 million

**No. of Employees:** 20-50

**Key Customers:** Telecommunications and optoelectronic industries, universities and research laboratories in Canada, U.S., Europe and Japan

### **Company Background**

Waterloo Scientific was incorporated in 1983 to commercialize a scanning laser microscope which had been initially developed by the Department of Physics at the University of Waterloo. The first microscope was delivered in 1986. Since then, the product line has been expanded. The company has expertise in the areas of semiconductor physics, optics, electronics, software and mechanical design and more specifically in material testing, optics design, system integration, image analysis, spectroscopy, precision motion, machine vision, robotics control, etc.

**PART II: RESEARCH INSTITUTE PROFILES**

## **BELL-NORTHERN RESEARCH LTD.**

P. O. Box 3511, Station C  
OTTAWA ON K1Y 4H7  
CANADA

Tel: (613) 763-2211  
Fax: (613) 763-8676

Key Personnel: Dr. R. L. Kriegler, Assistant Vice President, Advanced Technology

### **Overview**

Bell-Northern Research (BNR) is one of the world's largest telecommunications R&D organizations. The company is owned 70 per cent by Northern Telecom and 30 per cent by Bell Canada. BNR pioneered digital telecommunications systems and technology, and continues as a global leader in this field. BNR's key strength has always been its ability to combine technologies in innovative ways to build product platforms and systems that lead the telecommunications industry in functionality, longevity, and value for customers. Each year, BNR hires hundreds of new university graduates. The company works closely with universities to build bridges between the world of business and the world of education and pure research.

### **Organization**

BNR operates laboratories in nine sites around the world, including two in Canada (Ottawa and Montreal), three in the United States (Raleigh, Richardson, and Atlanta), two in the United Kingdom (Harlow and Maidenhead), one in Japan (Tokyo), and one in Australia (Sydney). BNR's more than 8,500 R&D professionals and support staff perform multi-site project development through one of the world's most advanced internal communications networks, linking all labs.

### **Research**

BNR's core technologies include silicon integrated circuits, optoelectronics, fibre optics, high-speed gallium arsenide integrated circuits, computer-aided design tools, simulation and test tools, computing technology, networks and network architectures, network planning, digital signal processing, digital line-card technology, and digital radio, including cellular and microwave. Based on these core technologies, BNR's engineers and scientists are currently

directing their leadership in market-responsive R&D at the next major challenges in telecommunications technology:

- FiberWorld, Northern Telecom's vision of end-to-end fibre-optic networks based on global SONET/SDH standards
- Advanced intelligent networks
- Multimedia communications
- Wireless personal communications systems, including digital cellular and low power wireless networks

BNR's photonics activities fall into two broad categories:

- System design and testing of long-distance high-speed transmission systems
- Optoelectronic component development

BNR has capabilities as a systems designer and as a systems integrator, as well as a component supplier and subsystem assembler. BNR has capabilities for modelling, simulating and testing long-distance high-speed transmission links for speeds of up to 10 Gb/s. BNR also makes use of external laboratories for exploratory work, because its mandate is primarily for product development work and also because laboratory are becoming increasingly capital intensive and specialized.

### **Facilities**

Major capital equipment in the Ottawa laboratory include molecular beam epitaxy, chemical beam epitaxy, MOCVDs, 10 Gb/s bit-error-rate test set. BNR has the only facility in Canada for the testing of long-distance extremely high-speed links.

## **SOLID STATE OPTOELECTRONICS CONSORTIUM OF CANADA**

340 March Road, Suite 400  
KANATA ON K2K 2E2  
CANADA

Tel: (613) 993-1506  
Fax: (613) 957-8734

Key Personnel:     Dr. John Elliott, President  
                         Dr. Richard Normandin, Program Head

### **Overview**

The Solid State Optoelectronics Consortium of Canada (SSOC) conducts research in integrated optoelectronics with the objective to enable Canadian industry to achieve leadership in the introduction of systems and products based on this technology.

### **Organization**

SSOC was incorporated as a federal non-profit Research Corporation in August 1988 and began operations in April 1989. It is an open consortium with industrial members and non-industrial research affiliates. Its program consists of three parts:

- the SSOC/Member Program, funded by SSOC Members and contracted to NRC, universities and companies;
- the SSOC/NRC Program, funded by NRC and performed at NRC by NRC staff; and
- the NRC Related Program which is that part of the regular programs of the Institute for Microstructural Sciences which relates to optoelectronics.

Current private sector members in SSOC, include BNR, EG&G Optoelectronics Canada and MPR Teltech Ltd. Public sector research affiliates include the National Optics Institute, the Communications Research Centre and TRLabs, as well as the National Research Council (NRC). Strong links are maintained with university researchers, who perform much of the materials and device research on a contract basis, and with centres/networks of excellence, who apply the technology to the design of systems and products. International linkages are maintained with leading edge research and applications activities in the U.S., Europe and Japan.

## **Research**

The emphasis of SSOC's activities is in high-speed electronics and optoelectronics and the application of these technologies to system and product design.

### **1. WDM transmit-receive modules**

- InP-InGaAsP based
  - CBE material growth techniques
  - Laser design and testing
  - Monolithic detectors and modulators
  - Microfabrication techniques
  - Integration issues
  - Long wavelength sources
  - Modelling (optical and electrical)
  - Patterned substrate growth
  - Active optical interconnects
- AlGaAs/InGaAs/GaAs based
  - MBE regrowth and patterned substrates
  - Laser integration
  - Monolithic amplifiers
  - Optical interconnects
  - Modulators and detectors
  - Integration techniques
  - OEICs
  - Modelling (optical and electrical)
  - DFB - DBR tunable lasers
  - Echelle grating receivers
  - MSM detectors
  - FIB milling and facet fabrication

### **2. Novel devices**

- Circular grating lasers
- Novel direct-write photolithography for DFB lasers
- Surface emitting DBR lasers
- Nonlinear visible diode lasers
- Optical nonlinear microwave spectrometers



- Large angle deflectors and spatial modulators
- (111) and (100) laser growth
- Harmonic generation in InP
- Synthetic integrated optics
- Array optics
- High-speed devices
- MSM arrays
- vertical cavity surface emission lasers (VCSEL)
- Nonlinear visible VCSEL

### **Facilities**

The facilities of SSOC are located within the Institute for Microstructural Sciences (IMS). SSOC has capabilities for material processing, device fabrication, modelling, design and testing of GaAs and InP-based devices. The clean room contains a chemical beam epitaxy facility, and is supported by extensive facilities and equipment from IMS, including an molecular beam epitaxy system, a focused ion beam processing system, x-ray photoluminescence and Raman spectrometers, an electron beam writer and reactive ion etching.

### **Industrial Involvement**

SSOC is an open consortium. New participants willing to contribute to SSOC's objectives and research and applications activities are welcome.

## **NATIONAL OPTICS INSTITUTE**

369 Franquet Street  
SAINTE-FOY QC G1P 4N8  
CANADA

Tel: (418) 657-7006  
Fax: (418) 657-7009

Key Personnel:      Dr. Charles E. Beaulieu, President  
                            Dr. Pierre Lavigne, Scientific Director

### **Overview**

The National Optics Institute (NOI) performs research activities in optics and photonics within five sectors: optical systems and components, photonics materials and processes, photonics and guided optics, lasers and information processing.

### **Organization**

Incorporated as a private, non-profit organization in December 1985, NOI is governed by a Board of Directors consisting of representatives from industry, government, and university elected by its membership comprised of 26 Canadian companies and organizations. The Institute employs a full-time scientific staff of 22 Ph.D researchers and 33 M.Sc. research assistants. NOI also has 25 specialized technicians on staff.

### **Research**

The five sectors of NOI research include:

- Optical systems and components  
         This involves optical design and testing, diffractive optics, and metrology.
- Photonics materials and processes  
         This includes micromachining, thin films, and crystal growth.

- Photonics and guided optics  
This focuses on specialty optical fibers and applications, f.o. sensors, modelling and packaging.
- Lasers  
This examines new laser sources and laser applications.
- Information processing  
This includes optical information processing and digital signal processing.

Ongoing specific research is being conducted by NOI in the following areas:

- Waveguide and Device Modelling by BPM-CAD  
NOI has developed a user-friendly software package (BPM-CAD) based on several numerical methods, the core of which is the Beam Propagation Method (BPM). This software was used to analyze digitally-driven electro-optic modulators, to model multimode star couplers in polyamide materials and to develop a Ti:LiNbO<sub>3</sub> integrated laser Doppler Velocimeter along with devices such as a Michelson interferometer, frequency shifter, TE/TM mode converter and mode splitter.
- Integrated Optics on LiNbO<sub>3</sub> and LiTaO<sub>3</sub>  
Research efforts are under way on the development of guided wave devices on LiNbO<sub>3</sub> and LiTaO<sub>3</sub>. A well-developed reliable and fully characterized process for designing and fabricating Ti in-diffused waveguides in LiNbO<sub>3</sub> crystals is being established.
- VO<sub>2</sub> Films for Optical Switching  
Technology for VO<sub>2</sub> films has been developed at the NOI. Thin films of VO<sub>2</sub> are deposited on various substrates including glass, sapphire and germanium using the reactive DC magnetron sputtering technique.
- High Silica Planar Waveguide  
High silica has attractive features that enable interconnection losses to be minimized. The material has inherently low loss, and is compatible with optical fiber. At the NOI, high silica waveguide technology is under development as an extension of the well-established fiber fabrication process known as a flame hydrolysis process.

- Specialty Fibers

The NOI is developing specialty fibers for a variety of applications. For example, the NOI has been supplying photosensitive fibers, fibers for acoustic waveguides, metal-coated fiber and various fibers with specific non-standard parameters. Currently, fibers containing rare earth ions are being developed for optical amplifier applications.

## **Facilities**

Located in the Quebec Metro High-Tech Park, the NOI is housed in a building which was completed in 1988. It was designed to meet stringent dynamic stability standards and is divided into two sections totalling nearly 8,300 sq. meters with 5,300 sq. meters of laboratory space. Facilities include two fiber-optic drawing towers, a preform manufacturing laboratory, several clean rooms, various deposition systems, the most complete optical design, testing and characterization equipment in Canada, laser pantography and lithography systems, a wide range of sophisticated and powerful lasers, design and fabrication facilities for special purpose lasers, state-of-the-art equipment and specialized hardware for information processing, a mechanical workshop used exclusively for prototype development.

## **Industrial Involvement**

The NOI is supported by 11 industrial affiliate members and 14 industrial associate members. Since its mandate is to bolster industry, its activities are closely linked to industry's needs. In 1992-93, more than 32 per cent of its activities were directly supported by industry. NOI's goal is to increase this percentage to 50 per cent.

NOI is actively involved in research consortiums both on the national and the international scene. Through various types of collaborative agreements, NOI has carried out joint research activities with partners from industry, government research laboratories and universities.

## **INSTITUTE FOR INFORMATION TECHNOLOGY**

### **National Research Council Canada**

National Research Council Canada  
A.G.L. McNaughton Building (M-50)  
Montreal Road  
OTTAWA ON K1A 0R6  
CANADA

Tel: (613) 993-9010  
Fax: (613) 952-0074

Key Personnel: S.A. Mayman, Director General

### **Overview**

As part of the National Research Council (NRC), the Institute for Information Technology (IIT) focuses on industry-oriented research and development of software and systems by applying information technology to industry directly and in partnership with other NRC institutes. The research it conducts on new technologies helps to determine what works and what does not, before major commitments have to be made at industry level.

### **Organization**

The Institute for Information Technology is one of NRC's ten Engineering Research and Technology Institutes. With more than 50% of IIT's research staff working with external clients, IIT maintains an Industrial Liaison Office to facilitate and support the interactions between institute laboratories and their industrial clients. This office promotes awareness of institute capabilities, identifies industry requirements and negotiates agreements and working relationships. These working relationships are in the form of cost-shared collaborative projects.

### **Research**

The research program of IIT is focused on the creation and adaptation of software and systems technologies to permit Canadian industries to exploit these technologies in their operations, processes, and products. The program includes both the creation of generic software tools and software development methodologies, and the development of generic technologies for automation and systems integration.

There are three elements to the Institute's research program:

- software engineering
- knowledge-based systems
- sensor-based automation

Each of the three laboratories in the Institute is responsible for one research element and Photonic Systems is one of the projects of the Autonomous Systems Laboratory. Its objective is the development of high speed signal/image processing systems and sensor systems involving a combination of optical and electronic technology to achieve real-time acquisition and processing of information. The activities are directed at:

- system level applications of photonics in high performance computers;
- optical interconnections in/between computers and sensing; and
- new paradigms in parallel computing for pattern recognition with the use of photonics.

### **Facilities**

There are three laboratories within IIT on NRC's Montreal Road campus in Ottawa. The photonic systems equipment includes high frequency equipment, large frame lasers, fiber-optics equipment and a variety of computers.

### **Industrial Involvement**

IIT conducts its research program in collaboration with industry and also with government and university communities. The Institute focuses on technology transfer to industry, primarily through collaboration with individual organizations or through such alliances as PRECARN, TRIO, OPCOM and IDS. The photonics group is currently engaged in collaborative activities with Digital Equipment of Canada, IOTEK Inc., Andrew Engineering, Plaintree Systems, TRIO, OPCOM and IBM Research. Photonic technology has recently been transferred to Canadian Marconi, MPB Technologies, Bell-Northern Research and Bryenton Associates.

## **INDUSTRIAL MATERIALS INSTITUTE**

### **National Research Council Canada**

Optical Inspection Program  
National Research Council Canada  
75 De Montagne Blvd.  
BOUCHERVILLE QC J4B 6Y4  
CANADA

Tel: (514) 641-2280  
Fax: (514) 641-4627

Key Personnel:      Dr. Jacques Martel, Director General  
                         Dr. Paolo Cielo, Program Leader

### **Overview**

The Industrial Materials Institute is one of the NRC's science institutes which supports research in the physical sciences through its competitive research and development programs. The Optical Inspection Program of the Industrial Materials Institute (IMI/OI) focuses on research and development in optical sensors for on-line quality and process control in the materials processing industries.

### **Organization**

With its staff of 113 and expenditures of about \$13 million, IMI's programs focus on instrumentation sensors, metals and ceramics, industrial polymers, and integrated systems for material processing. The Optical Inspection Program of IMI consists of a team of six research members.

### **Research**

IMI/OI has recently developed sensors for robotic guiding in adaptive welding, 3-D profilers for sawmill process control, in-furnace fiber-optic sheet temperature sensors for control of continuous annealing, and infrared sensors for on-line monitoring of polymeric webs and lubricant layers on metal sheets. All of these sensors have been developed in collaboration with industrial partners and have found applications in the production line.

Ongoing research projects involve the development of speckle-insensitive triangulation techniques, temperature sensors by cavity integration, in-flight temperature and speed

monitoring of plasma-sprayed particles, characterization of thermal barrier coatings and surface defects on metallic sheets, evaluation of degree of curing of polymers and structural anisotropy of polymer composites by thermographic and light scattering analysis.

### **Facilities**

IMI/OI has the following equipment: a variety of lasers, including high-power CO<sub>2</sub> and YAG, cameras for visible, near-IR and thermographic imaging, detectors, optical instrumentation, blackbody sources, spectrometers, general purpose and dedicated electronics, as well as access to the Institute's pilot lines for metal forming, polymer moulding, plasma spraying, etc.

### **Industrial Involvement**

Collaborations are presently active with steel companies such as Stelco and Atlas Steel; aluminum companies such as Alcan and Reynolds Aluminum; advanced materials manufacturers such as Pratt & Whitney; as well as a number of industrial instrumentation manufacturers having benefitted from technology transfers.

Research contracts are now under way from Alcan, Reynolds Aluminum, Stelco, Pratt & Whitney, Genpak and Tremco.



## **INSTITUTE FOR MICROSTRUCTURAL SCIENCES**

### **National Research Council Canada**

Building M50, Montreal Road  
OTTAWA ON K1A 0R6  
CANADA

Tel: (613) 993-9369  
Fax: (613) 957-8734

Key Personnel: Dr. P.H. Dawson, Director-General

#### **Overview**

The Institute for Microstructural Sciences (IMS) is a government laboratory at the National Research Council Canada. Major themes of the Institute's research programs are advanced electronic devices, optoelectronics and electronic and photonic materials.

#### **Organization**

The IMS has ten functional groups which work in collaboration with each other on the four main program areas. These program areas which are subdivided into major projects, are carried out in partnership with industrial partners or individual companies. In addition to this research, the Institute provides client services on a cost recovery basis, licenses technology to companies and provides consulting services.

#### **Research**

The Institute supports growth of Canadian businesses through a program encompassing artificially structured materials, the behaviour of photons and electrons in such materials, processing techniques, devices, device integration, signal processing and exploratory applications.

- Optoelectronics Program
  - SSOC/NRC project
  - optoelectronic devices
  - laser technology

This program is developing the technologies which will result in optoelectronic

integrated circuits.

- Microelectronics Program

- silicon/germanium devices
- focused ion beam processing
- advanced silicon processes
- compound semiconductor devices
- on-site UHV processing

The objective of this program is to develop advanced semiconductor processing techniques and devices of potential importance to information technology.

- Advanced Components

- quantum well infrared detectors
- thin film technology
- high contrast electroluminescent displays
- heads-up display
- active noise control
- adaptive acoustic arrays
- superconducting thin films

This program identifies opportunities in knowledge base or microelectronics/optoelectronics programs and provides opportunities to companies which tend to be specifically product oriented.

- Knowledge Base Program

- nanostructures
- surfaces and interfaces
- quantum properties of solids

The purpose of this program is to supply the knowledgeable base required by the Institute in relation to the behaviour of electrons and photons in structured semiconductor materials and devices.

## **Facilities**

The IMS laboratory has capabilities in: epitaxial growth (molecular beam epitaxy, chemical beam epitaxy), microfabrication (lithography, etching, metal and insulator deposition), focused ion beam implantation, materials characterization (optical, electrical, structural, chemical), device design and testing, thin film deposition, acoustics and signal processing.

## **Industrial Involvement**

The Institute operates in partnership with many industrial companies and with other government agencies, especially The Department of National Defence and The Department of Communications.

It plays a leading role in three consortia:

- Solid State Optoelectronics Consortium  
A consortium with ten members with a five-year program to develop the technology for optoelectronic integrated circuits.
- Focused Ion Beam (FIB) Consortium  
Under the aegis of the Ottawa-Carleton Research Institute, this is an industry, government, and university consortium devoted to FIB processing. The Institute operates a major FIB facility.
- Canadian Audio Research Consortium  
A five-company consortium working on next-generation smart loudspeakers.

Other industrial interactions involve bilateral agreements in the form of research partnerships or research contracts. The Institute generates revenue or in kind assistance of over \$1 million per annum from such agreements.

## **COMMUNICATIONS RESEARCH CENTRE**

### **The Communications Devices and Components Research Branch**

3701 Carling Avenue  
P.O. Box 11490, Station H  
OTTAWA ON K2H 8S2  
CANADA

Tel: (613) 998-2720  
Fax: (613) 993-7139

Key Personnel:      Dr. K. O. Hill, Director of Optical Communications and Electro-  
                                         photonic Technologies  
                                         Mr. R. Kuley, Director of Advanced Devices and Reliability

### **Overview**

The Communications Devices and Components Research (DCR) Branch is concerned with the development and miniaturization of electronic and optical circuitry for use in future communications systems. The Branch has strong research programs in analog, digital and optical component development, and is actively working on the convergence of these technologies to achieve very powerful integrated subsystems.

### **Organization**

The Communications Research Centre (CRC) is a major research facility of the new department, Industry and Science Canada, with a staff of over 400 people and an annual budget of nearly \$50 million. The DCR Branch has a staff of 50 persons, an annual budget of \$5 million and close to 12,000 square feet of laboratory space, with roughly one third of these resources devoted to photonics-related research activities. The major clients of CRC include federal government departments, private industries and universities.

## Research

Photonics is one of several themes which DCR has identified for its research program. The following activities relate to this theme:

- Photonic Components: In this activity, optical couplers and wavelength-selective components are developed for signal routing and (de-) multiplexing in photonic networks, for sensor applications, and for laser tuning and stabilization. Both fiber-based and planar optical waveguide approaches are being pursued.
- Optoelectronics: This activity concentrates on the development of optoelectronic circuits, including the growth of alternative semiconductor materials, the design of novel devices and the fabrication of optical waveguide structures that will permit optoelectronic components to be integrated with microwave and high-speed digital technologies. Applications include high-speed signal processing and data transfer, high frequency broadband switching and phased-array antenna systems.

## Facilities

The facilities at CRC include:

- a complete microelectronics facility for the fabrication of devices and integrated circuits based on compound semiconductors which includes laboratories and equipment for growth of epitaxial layers by MOCVD, materials characterization, SEM and Auger analysis, dielectric deposition and etching, photolithography, thin film metallization, and packaging;
- computer-aided design and modelling facilities;
- microwave and optoelectronic measurement facilities, including automated on-chip probing;
- fused-tapered-fiber coupler fabrication jig for any wavelength or splitting ratio;
- a complete system for the fabrication of in-fiber Bragg gratings and filters based on UV photosensitivity;
- high-power lasers and optical analysis instrumentation for materials research;

and

- antenna test facility.

### **Industrial Involvement**

Much of the research is carried out through partnerships with private firms, universities, and other research organizations within Canada and abroad. The DCR Branch is a research affiliate of the Solid-State Optoelectronics Consortium of Canada, and is also actively involved in CRC affiliations with the Ottawa-Carleton Research Institute, Telecommunications Research Institute of Ontario, Canadian Institute for Telecommunications Research, Ontario Laser and Lightwave Research Centre and CANARIE Inc. The Branch is also attempting to develop other industry-based consortia to better exploit its various photonic technologies in marketable products.

## **DEFENCE RESEARCH ESTABLISHMENT VALCARTIER**

P.O. Box 8800  
COURCELETTE QC G0A 1R0  
CANADA

Tel: (418) 844-4301  
Fax: (418) 844-4511

Key Personnel:     Dr. Jacques Gilbert, Chief  
                         Robert Corriveau, Director EO Division

### **Overview**

The Defence Research Establishment Valcartier is the largest R&D laboratory of the Department of National Defence. Program activities include research, development, evaluation, and various equipment and system studies. The scope of these activities covers ordinance (rockets, propellants, launchers, guns, projectiles and guided weapons, explosives, pyrotechnics, flares and operational equipment), command and control (automatic data processing, decision aids), and electro-optics (sensing devices, lasers, eye and sensor protection).

### **Organization**

DREV has a workforce of over 560 employees, including some 150 research scientists. DREV has an annual budget of \$40 million and awards close to \$7 million per year in R&D contracts to Canadian industries and universities.

### **Research**

The DREV R&D program maintains and develops expertise in defence sciences and technologies. In the electro-optic field, research activities are devoted to the application of optics and electronics to surveillance, target detection and identification, fire control and counter measures. Laser research is aimed at their utilization in range-finders, trackers and countermeasures. Work is carried out in nonlinear optics and frequency conversion techniques in view of developing new laser sources for military applications. Present emphasis is on eye-safe lasers for range-finders, on blue-green lasers for underwater mine identification and on tunable mid-infrared lasers for jamming heat-seeking missiles. DREV is also working on remote sensing for the prediction of atmospheric propagation in the infrared, on visionics and thermal imagery, on image processing and pattern recognition.

### **Industrial Involvement**

Close collaboration exists between DREV and the National Optics Institute. NRC is also covering a broad spectrum of EO technologies, and collaboration between NRC and DREV is expected to increase via the Solid-State Optoelectronic Consortium.

Industrial expertise to various degrees for defence applications is found in the following major representative companies: Bendix Ayelex, Bomem, CDC, DALSA, EG&G, Hughes-Leitz, Istec, Lumonics, Optech and Spar Aerospace.



## **THE LASER INSTITUTE**

### **University of Alberta**

9924 - 45 Avenue  
EDMONTON AB T6E 5J1  
CANADA

Tel: (403) 436-9750  
Fax: (403) 437-1240

Key Personnel:     Dr. Don C. McKen, President and CEO  
                         Dr. Martin Cervenak, Director, Optoelectronics  
                         Dr. Vivian Merchant, Director, Materials Processing

### **Overview**

The Laser Institute is engaged in applied research, development and engineering of laser applications in materials processing, optoelectronics and laser-based metrology. In addition, the Institute operates a Laser Job Shop which provides custom cutting, welding and heat treating.

### **Organization**

The Laser Institute, owned by the University of Alberta was incorporated in December 1984 as a non-profit limited company. Senior staff include the President, two senior scientists, each heading one or more areas of expertise, and the job shop manager. Annual research and development expenditures are within the \$500,000 to \$1,000,000 range.

### **Research**

Through two divisions, the Materials Processing Research and Development Division and the Optoelectronics Division, the Laser Institute provides process and procedure development, design, prototype development, testing, consulting, and feasibility studies.

- The Materials Processing R&D Division  
     This division is involved in development of parameters for specific processing, including cutting, welding, heat treating and weld overlaying.

- The Optoelectronics Division

This division develops sensors incorporating lasers, as well as conducting research regarding applications such as laser read and write equipment for laser disc (WORM) or laser cards, laser modification of gate arrays, direct writing in microelectronics and laser scanning of text or images in reprographics, printers and advertising displays. This division also investigates methods of inspection and control, using both laser-based profilometry and image processing.

A core program of applied research and development is ongoing with a concentration on bringing lasers to bear in such areas as wear, corrosion, advanced fabrication techniques, advanced materials, local and remote sensing and automated inspection. The spectrum of technologies span laser-induced ablation, cladding, heat treating, surface alloying, cutting, welding, optical time domain reflectometry, differential absorption, laser-induced fluorescence, interferometry, holography, and laser acoustic microscopy.

Examples of projects that have been completed include an extensive study of surface modification to improve the corrosion resistance of nickel-aluminum bronze valves, development of a process to apply titanium nitride ceramic onto check valves, a feasibility study to assess the potential of induced fluorescence for identification of decay in aspen development and construction of specialized laser scanning and surface profile measuring systems. Another project currently under way, involving hard-facing of components, may result in decreased wear in oil sands operations.

## **Facilities**

Specialized equipment at the Laser Institute includes:

- 50 watt CO<sub>2</sub> laser system with 1.5'x1.5 workstation
- 1000 watt CO<sub>2</sub> laser system with rotary workstation
- 1600 watt CO<sub>2</sub> laser system with 4'x8' workstation
- 5000 watt CO<sub>2</sub> laser system with 15"x3' workstation
- optical time domain reflectometer
- laser profiler
- machine vision/image processing system

## **Industrial Involvement**

Industrial participants have supported The Laser Institute through contract research. For example:

- Aastra Aerospace
- Canadian Space Agency
- Centre for Frontier Engineering Research
- Compressor Supplies and Machine Works Ltd.
- Defence Research Establishment Atlantic
- Defence Research Establishment Valcartier
- Esso Resources
- Global Laser Systems
- Greening Donald Ltd.
- Hycal Hydrocarbon Research
- Industrial Wire and Iron
- National Research Council of Canada, Space Division
- Pratt & Whitney Canada
- Sherritt Gordon Ltd.
- Standard Aerospace
- Steltech
- Syncrude Canada Ltd.
- University of Saskatchewan
- Whiteshell Nuclear Research Establishment
- Zard Aerospace

The Institute is also associated with the Canadian Industrial Laser Association, the National Optics Institute and the Electronics Network Association of Alberta.

## **TRLabs**

800 Park Plaza  
10611 - 98th Avenue  
EDMONTON AB T6E 5Y7  
CANADA

Tel: (403) 441-3800  
Fax: (403) 441-3600

Key Personnel:      Dr. R. I. MacDonald, Director, Photonics  
                         Dr. J. Conradi, Chair of Fiber Communications

## **Overview**

TRLabs is a western Canadian research consortium. Its research program centres its efforts on applied research in telecommunications, focusing on photonics, wireless, telecommunications networks and systems and network access technologies.

## **Organization**

TRLabs was established in 1986 as the first telecommunications research consortium in Canada - the result of a strategic alliance between Bell-Northern Research, the University of Alberta and the Government of Alberta. TRLabs currently operates research laboratories in Edmonton, Calgary and Saskatoon, and has plans for additional ones in western Canada. It has an annual budget of about \$7 million and a staff of over 120, consisting of staff researchers, industry professionals on secondment, professors, graduate and undergraduate students, and technical and administrative support staff.

## **Research**

The Photonics Division operates the TRLabs Edmonton laboratories. The research program has activities in: high capacity optical transmission, photonic switching for broadband signals, integrated optical interconnections, optical subscriber systems, and optical sensing.

Following is a brief description of the ongoing projects in the Photonics Division.

- Optoelectronic Switching and Signal Processing  
In this project, optical and electronic techniques are being combined to provide the matrix-vector product operation for very high frequency signals. The approach is to use electronics and optics for the functions best suited to each.
- Waveguides on Silicon Substrates for Hybrid Optoelectronic Integrated Circuits  
New ways are being developed to fabricate optical waveguides on silicon substrates for use in hybrid optoelectronic integrated circuits (OEICs). The objective of this project is to achieve an optical equivalent to the printed circuit board. Research efforts in this case are concentrated on silicon v-groove waveguide technology.
- Integrated Optoelectronic Devices  
Future systems will likely rely on monolithic integration of components such as laser diodes, optical amplifiers, modulators, detectors, and waveguiding structures. TRLabs has initiated research efforts to investigate novel integrable devices based on multiquantum well (MQW) materials.
- Fiber-Optic Transmission and Fiber-Optic Networks  
The TRLabs fiber-optic transmission program is designed to achieve greater utilization of the large transmission capacity of optical fibers.
- Local Area Photonic Networks  
The photonic networks of the next decade will extend into the home, will have a channel capacity many times that of existing telephone and CATV systems, and will rely on photons in place of electrons. TRLabs has been applying innovative approaches to key problems in local area photonic networks that have not yet been solved.
- Photonic Sensors  
As photonics matures in telecommunications practice, new test and measurement requirements emerge. TRLabs is able to identify such problems because of its close relationship with operating companies.

At TRLabs, students are supervised by professors of the member universities, and are registered for courses and degree programs at one of these institutions. All graduate research programs are co-ordinated with the interests of the sponsor companies, who also place staff at TRLabs. Student research is therefore closely linked into front line Canadian research in telecommunications, and students work in an industrial research environment.

## **Facilities**

Located in Edmonton, TRLabs Photonic Research Division has a well-equipped laboratory with capabilities for optical system characterization at Gb/s rates, for fabrication and testing of optical, electronic and optoelectronic devices and systems at GHz bandwidths, for coherent optical and interferometric experimentation and for fabrication and measurement of high-quality integrated waveguide devices.

## **Industrial Involvement**

TRLabs' major industrial involvement is through sponsorship. The current industrial sponsors are:

- BNR
- Northern Telecom
- ED TEL
- Digital Equipment of Canada
- SaskTel
- Digital Systems Group
- SED Systems Inc.
- AGT
- LSI Logic
- Develcon Electronics
- QCC Communications Corporation
- Wavecom Electronics
- Harding Instruments
- Pelorus Navigation Systems
- Photonic Gauge Systems
- SMART Technologies
- Southern Telecommunications
- VisionSmart
- Universities Alberta, Calgary and Saskatchewan
- Governments of Canada, Alberta and Saskatchewan

TRLabs has formed strategic alliances with:

- Stentor
- Alberta Microelectronics Centre
- The Laser Institute

Electronics Test Centre  
Electronics Industry Association of Alberta  
Solid State Optoelectronics Consortium  
Canadian Institute for Telecommunications Research  
Communications Research Centre  
Telecommunications Research Institute of Ontario  
Vision 2000  
National Wireless Communications Research Foundation  
Telecommunications Consortium of Canada

## **CANADIAN INSTITUTE FOR TELECOMMUNICATIONS RESEARCH**

McGill University  
3480 University, Suite 633  
MONTREAL QC H3A 2A7  
CANADA

Tel: (514) 398-8104  
Fax: (514) 398-4470

Key Personnel: Dr. Maier Blostein, President and CEO  
Prof. Scott Hinton, Major Project Leader, Photonic Devices and Systems

### **Overview**

The Canadian Institute for Telecommunications Research (CITR) is a non-profit corporation that manages research activity related to telecommunications under the Network of Centres of Excellence program of the Government of Canada. The research projects aim to enhance the competitiveness of the Canadian telecommunications industry.

### **Organization**

At CITR there are 67 professors, 157 graduate students, 24 post-doctoral fellows, 15 technicians and 33 other professionals involved in conducting research at its 17 centres across the country. The photonics research involves six of these professors and approximately 12 graduate students.

The Institute's six main areas of research are: broadband networks and services, optoelectronic devices and systems, communications software engineering, mobile communications, wireless indoor digital communications, and source and channel coding.

### **Research**

The current CITR Program in Photonic Devices and Systems is a major project ongoing in the development of photonic interconnection technology such that it will enable the development of large ATM switching fabrics and/or high performance digital computers of the future. The specific research demonstrator pursued in this major project will be an optical backplane, that will be capable of supporting terabit capacities.



The four projects the Photonic Devices and Systems Program will be conducting in the future are:

- Optoelectronic Devices:  
This project involves continued collaboration with BNR and SSOC to explore and test both high performance InP-based SL MQW lasers and CG-VCSELs. Research will explore the monolithic integration of HFETs and MSM in InP based materials.
- Optoelectronic Packaging Concepts:  
This project will explore and demonstrate hybrid optoelectronic packaging components and strategies that will apply to the development of a terabit capacity optical backplane.
- Optical and Optomechanical Hardware:  
This project will explore and demonstrate the optical and optomechanical technology required for the development of a terabit capacity free-space optical backplane.
- Large ATM Architectures:  
This project involves the development of large ATM architectures that are based on the use of a connection-intensive optical backplane capable of supporting terabit aggregate capacities.

Past CITER optoelectronic research was conducted in the following areas:

- Strain Layer Quantum-Well Lasers
- Optoelectronic Integrated Circuits
- Broadband Switching Technology
- Optical LANs

### **Facilities**

The CITER head office is located at McGill University. CITER's university members are: Carleton, Concordia, McGill, McMaster, Queen's, Montréal, Laval, British Columbia, Ottawa, Toronto, Victoria, Waterloo and Ecole Polytechnique. McGill and McMaster universities are doing photonics research and their laboratories are capable of materials growth, processing and characterization. TRLabs is also involved with CITER's photonics research.

**Industrial Involvement**

BNR is an industrial affiliate of CITR. There is also collaboration with TRILabs, NRC (IMS and IIT), SSOC and Institut National de la Recherche Scientifique.

## **TELECOMMUNICATIONS RESEARCH INSTITUTE OF ONTARIO**

340 March Road, 4th Floor  
KANATA ON K2K 2E4  
CANADA

Tel: (613) 592-9211  
Fax: (613) 592-8163

Key Personnel: Peter Leach, President  
James McPherson, Director, Member Services

### **Overview**

The Telecommunications Research Institute of Ontario (TRIO) is structured to enhance the technological competitiveness of Canadian telecommunications companies through university/industry partnerships in shared research programs. TRIO is an acronym for the institute's full name, as well as representing the three groups that work together: industry, university, and government.

### **Organization**

TRIO is a Centre of Excellence funded by Ontario's Premier's Council Technology Fund. It brings together over 250 communications researchers and postgraduate students from its four founding member universities: Carleton, McMaster, Queen's and the University of Ottawa. Additional researchers and graduate students participate in TRIO projects at associated institutions such as the University of Waterloo. TRIO is federally incorporated with a Board of Directors, President and several operating committees. Membership in TRIO is divided into three categories: University members, Interactive Industrial members, and Associate members.

### **Research**

Photonics research is conducted to investigate potential new optical communications methods and to initiate activities in optical communications, networking and optical component design. Studies include methodologies for transmission and networking with the goal of creating a conceptual design for a multigigabit per second local optical network. As a longer term initiative, TRIO is studying the fundamental issues in the development of optoelectronic techniques for the capture, transmission and reconstruction of 3-dimensional images.

Following is a description of specific photonic research projects TRIO is conducting in 1993/94.

- Optical Network Architectures (University of Ottawa)  
This project involves the research of the potential key network architectures and systems of likely importance in future optical networks. The concentration of the research is on the design and analysis of those network architectures that incorporate multi-wavelength transmission. Also, provisions have been made to accommodate new high-speed network interfaces such as ATM, HIPPI and SONET.
- Optical Network Protocols (McMaster University)  
This project comprises studies of switching methods and network design alternatives which will be applicable in future high-speed networks. The focus is on Local, Metropolitan, and Wide Area Networks in both single and multi-hop configurations.
- Optical Network Access Technology (Queen's University)  
Research in this area is based upon two principles: (a) the fiber bandwidth can be accessed more easily in the wavelength domain, and (b) multi-wavelength technology can be used to perform network functions such as routing, switching and service segregation.
- Optical Interconnections for WDM Optical Communication Systems (University of Waterloo)  
This project is designed to investigate key optical guided-wave devices and interconnect schemes for optical communications systems, especially for photonic networks based on wavelength division multiplexing.

## **Facilities**

Photonics research is performed at the university centres (McMaster, Queen's, University of Ottawa and University of Waterloo) under the supervision of Principal Investigators who co-ordinate research efforts and communicate regularly with TRIO members.

## **Industrial Involvement**

TRIO exchanges research information with the telecommunications industry and similar research centres in Canada, the U.S., Europe and around the world.

TRIO's industrial members include:

- 3M Canada Inc.
- Alex Parallel Computers Research Inc.
- Andrew Canada Inc.
- Antel Optronics Inc.
- Apriel Inc.
- Bell Canada
- Bell Mobility Cellular
- Bell Northern Research
- CAL Corporation
- Canpolar Inc.
- ComDev Ltd.
- Domus Software Ltd.
- Gandalf Technologies Inc.
- IBM Canada Ltd.
- Lockheed Canada Inc.
- Loran International Technologies Inc.
- Mitel Corporation
- Motorola Canada Ltd.
- Newbridge Networks Corporation
- Object Technology International Inc.
- Plaintree Systems Inc.
- Precise Software Technologies Inc.
- Prior Data Sciences Ltd.
- Prologic Systems Ltd.
- SkyWave Electronics Ltd.
- Spar Aerospace Ltd.
- Telesat Mobile Inc.
- Westinghouse Canada
- Worldlinx Telecommunications Inc.

## ONTARIO CENTRE FOR MATERIALS RESEARCH

P.O. Box 1146  
KINGSTON ON K7L 4Y5  
CANADA

Tel: (613) 545-6519  
Fax: (613) 545-6510

Key Personnel: Dr. J. P. McGeer, Managing Director  
Dr. David Thompson, Director of the Centre for Electro-phonic  
Materials and Devices (McMaster University)

### Overview

The Ontario Centre for Materials Research (OCMR) conducts research in telecommunications for the benefit of Ontario industry. The research includes biomaterials, electronic and optoelectronic materials, films, surfaces and coatings, metals and ceramics, composites and polymers and plastics.

### Organization

The Centre is a Canadian corporation with a Board of 16 directors. The OCMR involves over 80 investigators at the Universities of McMaster, Ottawa, Queen's, Toronto, Waterloo and Western Ontario working in co-operation with several hundred other researchers. Its program is directed by a Program Management Committee composed of four industrial representatives and three university representatives. OCMR is a Centre of Excellence funded primarily by Technology Ontario.

### Research

The Optoelectronics Materials Research Program is oriented toward the development of optoelectronic integrated circuits (OEICs) for optical communications systems. It includes fundamental materials studies, device fabrication technologies and the fabrication and testing of active and passive components required for communications OEICs.

The research program can be separated into various projects although they are all linked towards the common goal of OEIC development. Projects include MBE growth in  $\text{In}_{1-x}\text{Ga}_x\text{As}_y\text{P}_{1-y}$  on InP, optical waveguide studies using III-V semiconductors and glass media. Other work includes device testing to establish failure mechanisms and diagnostics to

characterize the high-speed performance of devices.

**Facilities**

An extensive array of facilities has been established for materials growth, device processing and characterization. Currently, OCMR has in place a gas source MBE system, ECR plasma deposition system, a combined sputter/evaporation deposition chamber, reactive ion etching, photolithography and processing equipment and extensive characterization facilities.

**Industrial Involvement**

OCMR researchers in the Optoelectronic Materials group are actively involved with researchers at BNR and the National Research Council of Canada. Other companies involved in various parts of the program include COMDEV, EG&G Canada and Optotek Ltd.

## **ONTARIO LASER AND LIGHTWAVE RESEARCH CENTRE**

Room 1102  
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10 King's College Road  
TORONTO ON M5S 1A4  
CANADA

Tel: (416) 978-5210  
Fax: (416) 971-2117

Key Personnel:     Dr. P. Smith, Executive Director  
                         J. M. Wilson, Manager, Administration and Communication  
                         Dr. M. Hubert, Resource Facility Manager

### **Overview**

The primary objectives of the Ontario Laser and Lightwave Research Centre (OLLRC) are to contribute to the scientific and technological knowledge base by supporting outstanding laser and lightwave research, to promote and assist the transfer and diffusion of advanced technology to business and industry in Ontario, and to train and develop highly skilled personnel.

### **Organization**

The OLLRC is one of Ontario's seven Centres of Excellence created in 1988. It consists of 18 member scientists and over 100 graduate students and senior researchers, located at the University of Toronto, York University, Sir Wilfrid Laurier University and University of Western.

### **Research**

Currently, commercially relevant basic research is conducted in concert with industry in the following areas:

- photonic device development for telecommunications applications;
- fast response photorefractive media for applications in optical data storage;
- optical studies of semiconductor and metal surfaces; and
- studies of non-linear optical phenomena and optical inspection systems.



The OLLRC regularly consults with small, medium and large companies to explore issues and concerns and to incorporate new approaches into the design process.

In the area of Photonic Science and Technology, researchers are exploring novel optoelectronic device concepts, operating principles, structures and functions. The advanced photonic devices being developed at the Centre will play an important role in future communications, computing and sensing systems.

### **Facilities**

The OLLRC Resource Facility helps industries to launch new technologies, exploit new opportunities, develop marketable products, and promote profitable partnerships with universities and government by engaging in contract research, consulting and training, posting skilled personnel, conducting conferences and professional development courses and loaning equipment.

### **Industrial Involvement**

OLLRC researchers collaborate with many government agencies and industries in Canada and abroad including: Bell Northern Research, Northern Telecom, Alcatel, Alcan, Ontario Hydro, DeHavilland, the Communications Research Centre, National Research Council, JDS Fitel, Optotek and Spar Aerospace.

## **CANADIAN INSTITUTE FOR BROADBAND AND INFORMATION NETWORK TECHNOLOGIES INCORPORATED**

**University of Regina**

Faculty of Engineering  
University of Regina  
REGINA SK S4S 0A2  
CANADA

Tel: (306) 585-4381  
Fax: (306) 586-8202

Key Personnel:     Mr. P. Van Vliet, President and CEO  
                         Dr. E. H. Hara, Technology, R&D

### **Overview**

The prime focus of the Canadian Institute for Broadband and Information Network Technologies (CIBINT) is the development of new information technology systems dealing primarily with fiber-optic communications technologies.

### **Organization**

CIBINT was founded in 1989 as a wholly-owned research corporation of the University of Regina, in response to the need for joint industry-university research initiatives in fiber-optic networks and related systems. CIBINT operates with a team of engineers, scientists and graduate students with industrial experience and academic backgrounds in physics, electronic systems, information technologies and communications.

### **Research**

Current research is focused on the completion of the NET-FIVE universal fiber-optic \*Network and Fiber-To-The-Desk (FTTD) network systems to meet specific market applications. Other research projects, related to ATM (Asynchronous Transfer Mode) systems and broadband networks are under way.

Future technology direction is aimed at the development of broadband and multi-media services over the same high-capacity fiber-optic network, as well as other industrial applications of this network technology requiring high-level security, interference-free communications, or remote control operation in hazardous locations.

### **Facilities**

Researchers and graduate students have access to CIBINT's Fiber-Optics Laboratory, which is equipped for design of electronic information systems and development of fiber-optic network technologies.

### **Industrial Involvement**

Industrial support has come from the communications operations and manufacturing sectors, as well as from the industrial controls manufacturing sector, through contract research, access to information, provision of hardware and software and the installation of equipment for Alpha and Beta test sites.

The Natural Sciences and Engineering Research Council (NSERC) has been a major early financial contributor to the research program. Collaborative research and development agreements are in place with an electrical equipment manufacturer in Japan and with a major North American-based computer systems manufacturer for product and systems development.

## **PHOTOTHERMAL AND OPTOELECTRONIC DIAGNOSTICS LABORATORY**

**University of Toronto**

Department of Mechanical Engineering  
University of Toronto  
5 King's College Road  
TORONTO ON M5S 1A4  
CANADA

Tel/Fax: (416) 978-5106

Key Personnel: Dr. A. Mandelis, Director

### **Overview**

The Photothermal and Optoelectronic Diagnostics Laboratory (PODL) conducts research in the field of photothermal detection diagnostics and characterization with activities in many areas of high technology materials' nondestructive evaluation (NDE). Central to PODL is the research and development of novel measurement and instrumentation techniques for photothermal NDE and materials research in the optical and thermophysical properties of the solid state.

### **Organization**

Established in 1982, PODL's current research group consists of five doctorates and six mechanical engineering graduate students working in the areas of laser thermorefectance, electoreflectance, thin-film photopyroelectric spectroscopy, engineering materials NDE, thermophysical property measurements, thermal-wave tomography, and Solid-State Laser Materials NDE. Frequent academic visitors include sabbatical researchers from Japan, China, Russia, Germany and Israel.

## Research

Listed below are descriptions of the research projects being conducted at PODL.

- Ultrasensitive Solid-State Spectroscopy  
A focus of this project's research has been the combined use of optical transmission spectroscopy and pyroelectric photothermal (photopyroelectric) spectroscopy (PPES) to obtain quantitative optical absorption coefficient information and non-radiative energy conversion efficiencies of laser crystals and thin semiconducting films on various absorbing substrates for the purposes of electronic defect characterization.
- Non-contact Transport and Defect-level Diagnostics of Semiconductors  
Using thermorefectance and infrared, radiometric laser-based instrumentation, PODL has achieved obtaining highly resolved separate information from thermal transport and electron-hole plasma transport without use of the conventional electrodes. This is industrially attractive for electrical and thermal substrate characterization at arbitrary stages of wafer fabrication.

A major new thrust is the generation and non-contact, all optical deep level transient spectroscopy (ODLTS) using the laser pump scheme with infrared radiometric detection. This new mode can monitor electronic defect levels due to impurities or due to processing and is a powerful diagnostic at the working device level, or earlier process stages. The work is supported by the Federal Government of Germany and industrially by Jenoptik GmbH and Mitel Semiconductors in Bromont, Quebec.

- Photothermal Solid-State Hydrogen Sensor  
An in-house designed and fabricated photothermal hydrogen gas sensor can monitor trace concentrations of  $H_2$  in the 40 ppm range, and under wide temperature ambients (-196°C to 60°C). R&D efforts are now focused in the adaptation of a sensor to room, laboratory and outdoors conditions as well as "intelligent" sensor arrays through a contract with Energy, Mines and Resources (EMR) Canada.
- Thermal-Wave Tomography and Depth-Profilometry  
PODL has introduced a novel, patented photothermal tomographic technology which can map (image) cross-sections of materials non-destructively and in the near surface region (a few microns to a few mm). A focused laser beam and narrow metallic pin are scanned across a material cross-section and the photothermal signal is recorded via a pyroelectric thin film at each relative laser-pin position. The reconstructed data constitute on tomogram. This work

is supported by NSERC.

### **Facilities**

PODL's laboratory includes a conventional Deep Level Transient Spectroscopy (DLTS) instrumentation facility for impurity and defect level research in optoelectronic substrates and interfaces, several lasers, spectroscopic and analytical instrumentation and complete photothermal/photoacoustic set-ups.

### **Industrial Involvement**

In the past four years collaborative projects have been carried out with the following industrial partners:

- Alcan Laboratories
- MITEL Semiconductors
- Ontario Hydro
- Crystar Research

PODL has collaborative agreements with:

- Energy Mines and Resources Canada
- Jenoptik GmbH
- Crystar Research Inc.
- Katholieke Universiteit Leuven
- Ecole Polytechnique Federale de Lausanne

## **CENTRE FOR OPTICS PHOTONICS AND LASERS**

### **Université Laval**

Faculty of Sciences and Engineering  
Pavillon A.-Vachon  
Université Laval  
Cité Universitaire  
QUEBEC QC G1K 7P4  
CANADA

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Key Personnel: Dr. Roger A. Lessard, Director

### **Overview**

The Centre for Optics Photonics and Lasers (COPL) is doing basic and applied research on lasers and guided optics, optical communications and photonics, image science and nonlinear optics and applications to materials. COPL's mission is to train graduate students in the fields of optics, photonics and lasers.

### **Organization**

The Centre was established in 1989, with professors from the Departments of Electrical Engineering and Physics. The Board of Directors of COPL is composed of 18 professors (14 from Physics, 4 from Electrical Engineering), 10 research associates, and 60 graduate students. Research members are predominantly physicists with Ph.D.s in optics, but some are physics engineers, chemists, or materials scientists, all with Ph.D.s.

### **Research**

Researchers of COPL are divided into four teams focusing on lasers and guided optics, optical telecommunications and photonics, nonlinear optics and its application to materials, and image sciences.

Specifically, research in the photonics area includes optical integrated circuits, optical switching, nonlinear waveguides, laser nanogravure sub-micron lithography, optical sampling and UV and X-ray generation.

In the area of optical communications, research is being conducted on the mode control in semiconductor lasers, frequency-stabilized lasers, optical frequency control by feedback, optical wave mixing, coherent optical communications and optical reflectometry.

Study of optical metrology centres on nondestructive testing, holography with visible, infrared or acoustic waves, speckle metrology and interferometry. Optics and information research is being conducted on the topics of liquid optics, digital image processing, neural networks, diffractive optics and optical memories.

Research in the materials and applied optics areas is being conducted on holographic optical elements, optical design, optical testing and optical recording materials.

The research devoted to fundamentals examines subjects such as nonlinear optics, ultra-short laser pulses, multiphoton processes, phase conjugation, optical bistability and nonlinear interferometry.

### **Facilities**

The COPL facilities are located at the University of Laval.

### **Industrial Involvement**

Members of COPL are collaborating with researchers from the National Optics Institute (NOI), the Defence Research Establishment at Valcartier (DREV), the Centre de Recherche industrielle du Québec (CRIQ), and the National Research Council of Canada (NRC). They also do collaborative work with researchers in Germany, France, Great Britain and the U.S.



## **CENTRE FOR ELECTRO-PHOTONIC MATERIALS AND DEVICES**

### **McMaster University**

McMaster University  
Faculty of Engineering  
HAMILTON ON L8S 4L7  
CANADA

Tel: (416) 525-9140 (7129)  
Fax: (416) 527-8409

Key Personnel: Dr. D.A. Thompson, Director

### **Overview**

The Centre for Electro-Photonic Materials and Devices (CEMD) develops methodologies for optoelectronic integrated circuits (OEICs) primarily for application in the area of communications. This program covers all aspects of research related to optoelectronic materials, devices, device technologies and integration. A smaller program in display devices is also carried out.

### **Organization**

Founded in 1987, CEMD currently comprises 14 full and part-time faculty, three industrial affiliates, four research scientists, four research assistants/technicians, four post-doctoral fellows and 35 graduate students. All are members from the Departments of Engineering Physics, Chemistry, Physics, Electrical and Computer Engineering, and Materials Science and Engineering at McMaster University.

### **Research**

The long-term research goals of the CEMD are targeted at the emerging area of materials and devices for optical communications systems and for display systems. Most of the work is centred on the III-V semiconductors with a smaller effort in the II-VI area.

All of the Centre's projects are concern OEIC development. Projects include MBE growth of  $\text{In}_{1-x}\text{Ga}_x\text{As}_y\text{P}_{1-y}$  on InP, optical waveguide studies using III-V semiconductors and glass media including work on optical switches and modulators, multiquantum well laser research for operation in the 1.3 and 1.55 $\mu\text{m}$  region and various device technology issues such as ion implantation and contact metallization for the development of a self-aligned contact

technology.

The Centre has recently fabricated the first InP-based digital optoelectronic switch, and is actively involved in the development of strained layer multiquantum well lasers that have improved operating characteristics over conventional heterojunction lasers.

### **Facilities**

Located at McMaster University, CEMD has recently established facilities for materials growth, device processing and characterization. Currently in place is a gas source MBE system, ECR plasma deposition system, a combined sputter/evaporation deposition chamber, reactive ion etching, photolithography and processing equipment and extensive characterization facilities.

### **Industrial Involvement**

Strong industrial collaborations exist with Bell Northern Research. Others occur through CEMD's industrial membership of the Ontario Centre for Materials Research and the Canadian Institute for Telecommunications Research.

Members of CEMD are part of a provincial Centres of Excellence program and one of the federal Networks of Centres of Excellence.

## **ÉCOLE POLYTECHNIQUE**

Department of Engineering Physics  
École Polytechnique  
C.P. 6079, Succ A  
MONTREAL QC H3C 3A7

Tel: (514) 340-4421  
Fax: (514) 340-3128

Key Personnel:      Professor R. Maciejko  
                            A. Yelon, Chairman

### **Overview**

The Department of Engineering Physics does applied and fundamental research in the areas of fiber optics, optoelectronics, integrated optics, molecular and photoacoustic spectroscopy, spectroscopy, plasma deposition, MOCVD, laser processing, device fabrication and characterization.

### **Organization**

The department has 19 professors, most of whom are actively involved in research. About 22 research associates complete the research staff. In 1990-91, the department budget for research was \$2.8 million, mostly research grants from government agencies, with about 25% coming from research contracts.

### **Research**

The department has sections involved in both optics and solid state physics. The various research areas include:

- Non-destructive analysis of materials by optical methods (FTIR-PAS) with application to thin films, polymers, semiconductors and organic materials;
- All-fiber devices such as fused couplers, interferometers, filters, sensors, non-linear effects and laser fibers;
- Spectroscopy with multi-photon processes and optogalvanic effect;

- Photonics, quantum-well lasers, device modelling and testing, prototype fabrication, Monte-Carlo modelling of carrier transport in photonic devices, time-resolved photoluminescence in picosecond and femtosecond regime;
- Integrated optics on glass, lithium niobate and polymers and integrated optic devices;
- Photovoltaic device research;
- MOCVD of III-V materials and quantum wells; and
- Direct laser writing and metal deposition for device fabrication.

### **Facilities**

The facilities are found in several laboratories. The major pieces of equipment are:

- several types of lasers: HeNe, HeCd, dye lasers, argon, Nd:YAG, Ti:sapphire, excimer and semiconductor
- fused fiber coupler fabrication
- picosecond and femtosecond optics; photoluminescence
- spectrometers: conventional and FTIR; optical spectrum analyzer
- several optical labs with optical tables and accessories for photonics, integrated optics and conventional optics
- fast electronics: sampling scope, spectrum analyzer, boxcar averagers, data acquisition systems
- fabrication facilities: clean room, photolithography, chemical processes and RIF. Etching and polishing

- material growth: MOCVD and LPE
- material characterization: X-ray diffractometer, ESCA lab, profilometer

### **Industrial Involvement**

Researchers in the department maintain close contact and collaborate with several government agencies and industries in Canada and abroad: Bell-Northern Research, CRC, National Research Council, EG&G, INRS, Hydro-Quebec, Northern Telecom, Bell Canada, Alcatel, Canstar, Bomem, JDS, Optonex and Nokia.

## ACOUSTO-OPTIC RESEARCH LABORATORY

### University of Toronto

University of Toronto  
Galbraith Building, Room 442  
35 St. George Street  
TORONTO ON M5S 1A4  
CANADA

Tel: (416) 978-7001  
Fax: (416) 485-0032

Key Personnel: Dr. V. M. Ristic, Laboratory Coordinator  
Dr. H. E. Ruda, Principal Investigator

### Overview

The Acousto-Optic Research Laboratory (AORL) is currently concentrating its efforts on applied research in optical (hybrid) computers and optical signal processors, digital signal/image processing, detectors and laser spectroscopy.

### Organization

AORL was founded in 1980 to carry out research contracts with Canadian industries and federal government departments. Its staff consists of three principal investigators, eight research associates, and 20 graduate students.

### Research

The AORL researchers are interested in many aspects of optical signal processors, photonics and image processing, including the following:

- Hybrid image processing in radon space  
The optical processor under development is intended to mimic the human eye and to interpret picture content in real time.
- Novel optical architectures for radar signal processing  
Optical architectures that are applicable to receivers of conventional and low-probability-of-intercept (LPI) radar signals are investigated.

- Nonlinear digital signal processing  
New types of non-linear filters for image enhancements and noise suppression are studied. Some have been used for object recognition.
- Image compression  
Morphological filters of fixed and adaptive types are being used to decompose images (grey level and colour) in an pyramidal structure. Progressive transmission of these images through channels is being studied.
- Detector studies based on epitaxial technologies  
Research is focused on studying molecular beam epitaxially (MBE) and liquid phase epitaxially (LPE) grown heterostructures for the development of ultra fast, high quantum efficiency photodetectors suitable for infrared, near-infrared and visible-based imaging systems.
- Laser spectroscopy and diagnostic  
This research involves a variety of spectroscopic techniques including photoluminescence, absorption, cathodoluminescence and surface photovoltage spectroscopy are being used to provide information on surface and impurity states, band structure and recombination mechanisms in semiconductor heterostructures. A parallel effort is directed at using spectroscopic techniques to identify and measure gaseous based species, principally by laser induced fluorescence (LIF) studies.

In the past 13 years, major achievements involved the design, prototype fabrication and testing of an integrated optical spectrum analyzer based on Ti in-diffused LiNbO<sub>3</sub>, integrated optics and its technology transfer to industry and design and realization of real-time hybrid (optical/digital) image processing systems.

### **Facilities**

AORL is located at the University of Toronto.

### **Industrial Involvement**

AORL is involved with local companies in various degrees of cooperation, such as numerical studies and measurement and fabrication of photonic devices.

## **THIN FILMS GROUP**

### **University of Montreal and Ecole Polytechnique**

Physics Department  
University of Montreal  
P. O. Box 6128, Station A  
MONTREAL QC H3C 3J7  
CANADA

Tel: (514) 343-6614  
Fax: (514) 343-2071

Key Personnel: Dr. John L. Brebner, Director

### **Overview**

The Thin Films Group conducts fundamental and applied research on thin films and surfaces. It is funded by federal and provincial governments and does contract research for government agencies and for industry.

### **Organization**

Founded in 1984, the Thin Films Group consists of 20 researchers (8 M.Sc. and 5 Ph.D.) and 55 students from the Physics Department of the University of Montreal and the Engineering/Physics Department of the École Polytechnique.

### **Research**

Research is currently being conducted on epitaxial layers, quantum wells and superlattices based on InP and related compounds. Some of the products and applications include:

- III-V Semiconductor Fabrication and Characterization
- Non-Linear Optics
- Rare-Earth Based Ion-Exchange Waveguides, Ion Implanted Waveguides
- Diamond-Like Coatings



## **Facilities**

The Thin Films Group operates out of the University of Montreal. It has three research facilities comprising:

- Surface Laboratory based on a VG ESCALAB;
- MODFAB, a preparation and characterization laboratory containing clean room photolithography, deposition and rapid anneal systems together with comprehensive characterization techniques (X-ray, electrical, photoluminescence);
- Ion Beam Laboratory providing high-energy implantation and several analytical ion techniques (channelling RBS, ERD and micro-PIXE).

## **Industrial Involvement**

The Thin Films Group has several contractual agreements with firms such as Mitel and Northern Telecom. It also has collaborative agreements with Canadian, U.S. and European Universities, the National Research Council, the Communications Research Centre and with Paprican.

## UNIVERSITY OF OTTAWA

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Fax: (613) 564-5952

Key Personnel: Dr. M. J. Farrall, Director, Research Services

### Overview

Lasers or optoelectronics and lasers related research is carried out in the departments of Electrical Engineering, Mechanical Engineering, Physics, Chemistry and Medicine at the University of Ottawa.

### Organization

The research group at the University consists of ten researchers with doctorates who specialize in photonics and its applications.

### Research

Specifically, the University undertakes research in photonic network architectures, optoelectronic materials, vision systems for robotics and flexible manufacturing, laser induced chemical reactions, and medical applications of lasers. Its researchers have developed a passive optical NxN star coupler, as well as other technologies in the optical communications field. The University was one of the first groups to use lasers in coronary endarterectomy.

The University of Ottawa is undertaking the following projects in the field of lasers and optoelectronics:

- Optical Communications  
Optical communications through air infrared laser communications is being examined for moderate distances (up to 5 km) to secure data transfer or for wireless backplane data transfer in computers. Development and implementation of a novel lossless N x N optical star coupler design. This project is expected to lead over the long term to a functional optical switch.

- Computer Vision  
Interest in computer vision for mobile robots has led to the development of an integrated tactile and vision sensing system for the space station dexterous manipulator, funded by the Canadian Space Agency. Development of a computer vision systems for flexible manufacturing applications is also ongoing.
- Medical Applications  
The application of lasers in coronary artery surgery and eye surgery is being studied by the Faculty of Medicine.
- Optoelectronic Materials  
A project to develop materials for rare-earth-doped glass optical amplifiers in collaboration with Bell-Northern Research Ltd. is under way. Optical and photoelectrical properties of semiconductor materials, with potential applications in tunable lasers, are being studied.

### **Facilities**

This research is being conducted at the University of Ottawa's laboratory.

### **Industrial Involvement**

The University of Ottawa carries out approximately \$50 million in sponsored research annually, of which some \$18 million is contract research with government or industrial sponsors.

The University is a participant of the Telecommunications Research Institute of Ontario (TRIO) and the Canadian Institute for Telecommunications Research (CITR). Bell Northern Research, Lumonics, Quadralogic, IMAX, and Shipley Company Inc. are industrial participants in the University's program. Additionally it has collaborative agreements with the National Research Council, the Department of Communications, and the Canadian Space Agency.

## **LASER AND ELECTRO-OPTICS LABORATORY**

**University of Western Ontario**

Department of Electrical Engineering  
The University of Western Ontario  
LONDON ON N6A 5B9  
CANADA

Tel: (519) 661-2128  
Fax: (519) 661-3488

Key Personnel: Dr. R. M. Mathur, Research Director  
Dr. Z. Kucеровsky, Researcher

### **Overview**

Research is focused on the development of near and far infrared lasers and associated electro-optical and electromechanical devices and systems such as: the charge of coupled devices and arrays, photodetectors and pyroelectric detectors, coherent and video receivers and modulators.

### **Organization**

There are three principal researchers and three graduate students on staff at the Laboratory. In addition, it co-operates with Western University's Departments of Physics, Engineering Science, and the Centre for Applied Electrostastics.

### **Research**

Two selected research projects the Laboratory is currently working on are:

- Stimulated Recombination Experiment  
The Laboratory, in conjunction with the University's Department of Physics is working on a major experiment in the stimulated radiative recombination. In the experiment, spontaneous radiative recombination between protons and electrons to form hydrogen atoms has been measured using a merged beam apparatus, field ionization detection and a computer controlled carbon dioxide laser. Infrared radiation from the laser has been shown to induce stimulated radioactive recombination.

- Laser Machining and Unusual Materials

Experiments have been carried out on the application of a medium power carbon dioxide laser for the machining of unusual materials such as sugar coated food substances. Laser parameters required in precision micromachining of sugar coatings have been determined, namely those needed for laser writing. The project yielded specification of a system suitable for production level computer controlled laser system, suitable for writing on sugar coated surfaces.

The Laser and Electro-optics Laboratory has developed several infrared lasers, studied and optimized their performance and has developed a number of systems suitable for work in the quantum and black-body radiation optics. These include carbon dioxide lasers, water vapour lasers, helium-neon lasers, detectors, optical signal processing systems.

### **Facilities**

The Laboratory is located at the University of Western Ontario in London, Ontario. Its facilities include a large water-vapour laser, a large carbon-dioxide laser and several small carbon-dioxide lasers. It also has a helium-neon and helium-xenon laser operating in infrared.

### **Industrial Involvement**

The laboratory has been involved with joint projects with the Atomic Energy Commission of Canada at Chalk River.

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