DEVELOPMENT OF A FIBRE OPTIC INTERFEROMETER WITH APPLICATION TO SENSORS, COMMUNICATIONS AND LASER INSTRUMENTATION

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DATE: 7 February 1984

SUBJECT / OBJET: Development of a Fibre Optic Interferometer with Applications to Sensors, Communication and Laser Instrumentation
Contract Serial Number 1ST83-00017
Executive Summary

The above executive summary is unclassified and is available for unlimited distribution.

D.C. Johnson

DCJ:msm

Attachment

CONTRACT SERIAL NUMBER - 1ST83-00017

DSS FILE NUMBER - 12ST.36001-3-5058

TITLE

DEVELOPMENT OF A FIBRE OPTIC INTERFEROMETER WITH APPLICATION TO SENSORS, COMMUNICATIONS AND LASER INSTRUMENTATION - UP-C-478

Executive Summary.

The summary contains 3 sections.

1. Applications
2. Technology Advancement
3. Commercial Exploitation

Applications

Single mode fiber for wide band and long haul communications requires couplers for input/output of signals that exhibit low loss, stable coupling ratio, low back scatter and environmental stability.

Interferometric sensors using laser diodes have even more stringent requirements in that back scatter must be virtually zero to ensure stable laser diode output. Sensors using resonance techniques require very low loss and in some cases a coupling ratio in excess of 99%.

This contract has resulted in successful development of tunable evanescent wave couplers and interferometric sensor assemblies which have the features for these applications and prototype systems have been delivered for evaluation.

There are several areas of future development which would be beneficial in increasing the usefulness of sensors.

Laser diodes with narrower line widths would allow longer fiber lengths and increased sensitivity in many sensors. Acousto-optic transducers using piezo-electric devices to directly modulate fiber are possible for frequency shifting and have application in rotation sensing. Couplers using 1.3 micron fiber will be necessary for data buses in the Gigabit range and means of mass production are required to achieve low cost couplers for a potentially explosive market.

Technology Advancement

Previous contracts involved with fiber technologies over the past few years have resulted in a general understanding of the interaction of laser diodes and single mode fiber.

The following sub headings give an appreciation of the range of topics.

a) Polarization effects in fiber.
b) Fabry Perot sensor systems, including single and dual cavity sensors.
c) Laser diode behavior with respect to feedback from sensor systems.
    i) Effect of amplitude and phase of coherent back scatter
    ii) Effect of incoherent back scatter
d) Decoupling techniques to eliminate feedback
e) Couplers
    i) Techniques for grinding and polishing to sub micron accuracies and low scatter surfaces
    ii) Optical techniques for assessment of ½ coupler characteristics in the manufacturing process.

iii) Understanding of the effect of index profile in coupler behavior

iv) Effects of index in the liquid interface of the coupler and the reduction of temperature dependence.

f) Sensor configuration including Fabry Perot, Ring Resonator, Sagnac and Mach Zehnder interferometer for hydrophone, accelerometer and other applications.

g) Potential applications for acousto-optically modulated fiber devices and Brillouin lasers.

h) Many ideas for practical mass production methods of 3dB couplers and lower ratio taps for communications have been examined and will be subject to continued development.

Commercial Exploitation

Optical couplers in both fixed and variable ratios have been offered for sale along with support equipment such as a laser diode stabilized power supply, a dual integrating cavity photodetector and input diode to fiber optical xyz stage (datasheets enclosed).

Advertising was begun in November '83 and in excess of 100 enquiries have been received to date. Purchase orders as of 25 Jan. '84 amount to $11,000.00 U.S. mostly for the U.S. market, and mainly involving research type variable ratio couplers. Low volume production can be handled by this company but serious consideration and planning will be necessary to make a breakthrough into the large volume lower cost communications market.

Further proposals are being made through DSS to continue development in sensors applications.

It is appropriate in this summary to offer thanks to all those scientific and administrative personnel in federal government defence research organizations and Supply and Services Canada for their interest and assistance over several years, which in many instances has reflected their understanding of the difficulties that a small company experiences.