NRC·CNRC

Aerospace

Active Seat Mount System for Rotorcraft

●●● Flight Research Laboratory

During helicopter flight operations, rotorcraft floor vibration is generated by the periodical rotor blade aerodynamic and inertial loads. This unwanted vibration is transmitted through the helicopter seat, exposing the aircrew to health-related issues caused by whole-body vibration (WBV).

Examples of issues caused by the regular exposure of aircrew to high WBV levels:

- Discomfort
- Decreased performance
- Increased fatigue
- Spine and neck injuries
- Chronic lower back pain

Since helicopter seats are primarily designed to withstand crashes, reducing vibration is often a secondary focus, which can lead to undesirably-high WBV levels.

Photo: Corporal Angela Gore, Canadian Armed Forces Photo

The Active Seat Mount System is a patented technology developed by experts from the National Research Council of Canada's (NRC) Aerospace Research Centre for reducing rotorcraft pilot WBV during flight operations. The system incorporates a set of actuators that adaptively counteracts vibration transmitted from the floor to the occupant. Flight-worthy prototype hardware of this technology has been developed for performance demonstration purposes.

In 2023, we tested this technology extensively using mannequin and human subjects in the NRC's human-rated shaker facility and completed several flight demonstrations on the NRC Bell-412 helicopter, which featured flight conditions that were typical of the vehicle.

Benefits of the Active Seat Mount System:

- Robust and adaptive to varying flight conditions and aircrew sizes
- Significant vibration attenuation simultaneously at multiple N/rev peaks
- Localized control method with promising performance with moderate energy input

Flight test results:

- Successfully completed four flight demonstrations on the NRC Bell-412 helicopter
- Achieved significant WBV reduction to the occupants in all tested flight conditions
- Reduced the N/rev peaks at the helicopter pilot seat cushion interface by 70% to 98%
- Reduced ISO-weighted overall WBV levels by 50% to 65%
- Extended aircrew exposure time limit from 3 hours to "unlimited" per ISO2631-1 standard guideline
- Improved the aircrew ride comfort from "fairly uncomfortable" to "not uncomfortable"
- Received very positive feedback on the ride experience of the Active Seat Mount from Human occupants

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