

## First Successful Flight Test of Energy Harvesting Wireless Sensor Nodes by MicroStrain, Inc.

Release Date: Immediate

Williston, Vermont, June 8, 2007 - MicroStrain, Inc. has announced, for the first time, a successful flight test of next generation wireless strain sensors for damage tracking of rotating helicopter parts and other critical dynamic components. MicroStrain also announces that its energy harvesting wireless strain sensing modules have been released for sale in the USA & through its distributors worldwide.

MicroStrain's sensing systems will operate indefinitely - without the need for batteries, by converting the component's cyclic strains into DC power using piezoelectric materials (patents issued & pending).

MicroStrain's miniaturized energy harvesting sensing nodes, called ESG-LINK™, feature a precision time keeper, non-volatile memory for on-board data logging, & frequency agile IEEE 802.15.4 transceiver (figure 1). Sampling rates, sample durations, sensor offsets, sensor gains and on-board shunt calibration are all wirelessly programmable.

Recent flight tests on a Bell Helicopter Model 412 (figure 2) has shown that MicroStrain's nodes will operate continually, without batteries, even under low energy generation conditions of straight and level helicopter flight. By continuously monitoring the strains on rotating components, the nodes can record operational loads, compute metal fatigue, and estimate remaining component life. To our knowledge, this was the first successful flight test of a wireless, energy harvesting sensor on rotating helicopter components.

The critical component instrumented on the Bell M412 was the pitch link (figure 3). The pitch link's controls the rotor blade's angle of attack as the rotor rotates through the air. Pitch link loads vary strongly with aircraft flight regimes, reaching much higher loads (6X) during pull ups and gunnery turns as compared to straight and level flight. Therefore the pitch link is an excellent

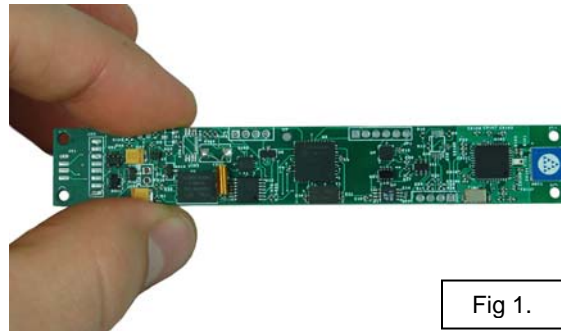


Fig 1.



Fig 2.

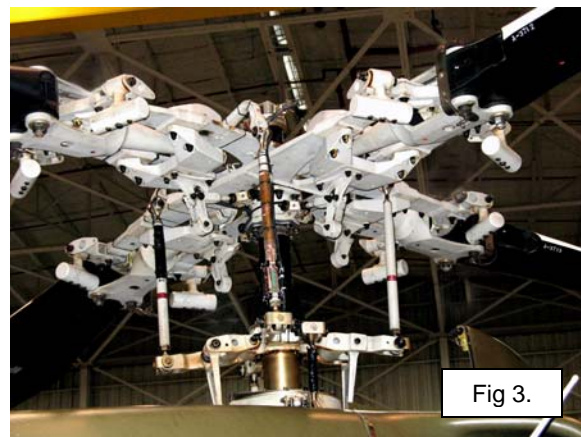


Fig 3.

indicator of vehicle usage severity, and can provide critical data for improved condition based maintenance.

Strain gauges bonded to the pitch link were arranged to cancel thermal and bending effects and to amplify tension/compression loads. Bench calibrations allowed the strain gauge bridge to provide load data during flight. While spinning at 5 revolutions per second, data were logged within the wireless node's non-volatile memory and also periodically transmitted to a small mobile base station located in the helicopter's cabin. Flight test data from MicroStrain's wireless nodes were compared to data collected by from hard wired strain gauges (using slip rings) with close agreement.

Reducing power consumption is a key requirement when energy harvesting, because the energy "checkbook" must be balanced to support continuous operation. MicroStrain's engineers have recently reported on smart wireless sensor nodes that adapt their operating modes in accordance with the amount of energy available<sup>1</sup>.

MicroStrain's latest *adaptive* energy harvesting wireless sensors can sample pitch link static and dynamic loads at a rate of 32 samples/sec, then communicate these wireless data into the helicopter cabin, while consuming only 250 microwatts. Compared to conventional Wheatstone bridge signal conditioning electronics (which draw 72 milliwatts), MicroStrain's e-harvesting wireless sensor node delivers an improvement of 288 fold.

"We're delighted to release our energy harvesting wireless sensing technology at Sensors Expo 2007. Our first successful flight test, performed in concert with Bell Helicopter, has demonstrated that our technology works. The potential of energy harvesting combined with wireless sensing will now begin to be fully realized, not only on rotating helicopter components, but on a wide range of machines, structures, and systems", said Steven Arms, MicroStrain's President.

This work was supported by a Navy Phase II SBIR award. MicroStrain is currently at the one year point of a two year SBIR contract with Navy/NAVAIR to transition this technology for health usage monitoring (HUMS) & structural health monitoring (SHM) of the Navy's helicopter fleet.

MicroStrain, Inc. is a leading designer and manufacturer of next generation wired & wireless networks for embedded displacement, strain, vibration, temperature and orientation sensing. For further information please visit MicroStrain's website at [www.microstrain.com](http://www.microstrain.com) or call 802-862-6629.

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<sup>1</sup> Arms et al., "Tracking Pitch Link Dynamic Loads with Energy Harvesting Wireless Sensors" Proceedings of American Helicopter Society 63rd Annual Forum, Virginia Beach, VA, May 1-3, 2007. PowerPoint presentation available on-line at: [http://microstrain.com/wireless\\_loads.aspx](http://microstrain.com/wireless_loads.aspx)