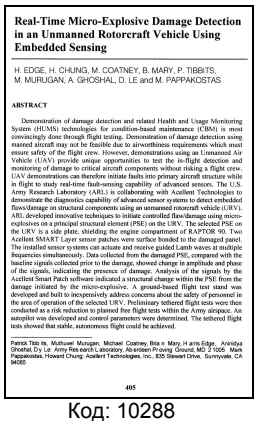
Real-Time Micro-Explosive Damage Detection in an Unmanned Rotorcraft Vehicle Using Embedded Sensing

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ABSTRACT

Demonstration of damage detection and related Health and Usage Monitoring System (HUMS) technologies for condition-based maintenance (CBM) is most convincingly done through flight testing. Demonstration of damage detection using manned aircraft may not be feasible due to airworthiness requirements which must ensure safety of the flight crew. However, demonstrations using an Unmanned Air Vehicle (UAV) provide unique opportunities to test the in-flight detection and monitoring of damage to critical aircraft components without risking a flight crew. UAV demonstrations can therefore initiate faults into primary aircraft structure while in flight to study real-time fault-sensing capability of advanced sensors. The U.S. Army Research Laboratory (ARL) is collaborating with Acellent Technologies to demonstrate the diagnostics capability of advanced sensor systems to detect embedded flaws/damage on structural components using an unmanned rotorcraft vehicle (URV). ARL developed innovative techniques to initiate controlled flaw/damage using micro-explosives on a principal structural element (PSE) on the URV. The selected PSE on the URV is a side plate, shielding the engine compartment of RAPTOR 90. Two Acellent SMART Layer sensor patches were surface bonded to the damaged panel. The installed sensor systems can actuate and receive guided Lamb waves at multiple frequencies simultaneously. Data collected from the damaged PSE, compared with the baseline signals collected prior to the damage, showed change in amplitude and phase of the signals, indicating the presence of damage. Analysis of the signals by the Acellent Smart Patch software indicated a structural change within the PSE from the damage initiated by the micro-explosive. A ground-based flight test stand was developed and built to inexpensively address concerns about the safety of personnel in the area of operation of the selected URV. Preliminary tethered flight tests were then conducted as a risk reduction to planned free flight tests within the Army airspace. An autopilot was developed and control parameters were determined. The tethered flight tests showed that stable, autonomous flight could be achieved.

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**Ключевые слова:**

**Содержание.**