Low-cost structural health monitoring system for engineering applications

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A low cost, low volume integrated sensor system has been designed using COTS (commercial-off-the-shelf) components to be deployed on engineering structures to apply non-destructive evaluation (NDE) techniques for structural health monitoring. The prototype system has been successfully installed and employed on full-scale aerospace tests in Airbus facilities in the UK and France.

Individual rugged modules combine point (resistance strain gauges) and full-field (optical and infra-red) sensors with a credit-card sized board computer for on-board data collection and processing. Modules are deployed at regions of interest on an engineering structure, with data collection, transfer and storage controlled by the user through a custom designed graphical user interface on a control computer connected to all modules.

Using these sensors, a range of NDE techniques are possible, and can be tailored to the individual loading scenario, material, and conditions. For example, visible light camera sensors allow digital image correlation (DIC) with suitable surface preparation, and infra-red cameras allow thermographic methods to be utilised under appropriate loading conditions.

The processing software developed for the system includes algorithms for the generation of DIC and the thermographic method CATE (Condition Assessment by Thermal Emission) data. Further algorithms have also been developed that apply an image decomposition technique to these full-field datasets, allowing quasi real-time quantitative comparison over time, which can be used for condition monitoring. The processing algorithms are not sensor specific, so can be applied to image data from other sensors, allowing historical datasets or datasets from external cameras to be post-processed.