

Acoustic Techniques for Structural Health Monitoring

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Future safety and maintenance strategies for industrial components and vehicles are based on combinations of monitoring systems, which are permanently attached to or embedded in the structure, and periodic inspections. Periodic inspections belong to conventional nondestructive evaluation (NDE) and can be enhanced or partly replaced by structural health monitoring systems. This approach will increase the efficiency of inspection procedures and reduce inspection time. However, the main benefit of this technology in the far future will consist in systems that can be designed differently based on an improved safety philosophy that includes continuous monitoring.

The Dresden branch of Fraunhofer IZFP has developed network nodes, miniaturized transmitters and receiver systems for active and passive acoustic techniques and sensor systems that can be attached to or embedded in components or structures. These systems have been used to demonstrate intelligent sensor networks for monitoring of aerospace structures, railway systems, wind energy generators, pipes and others. Defects have been detected and monitored during full scale fatigue tests has been performed. This paper will discuss opportunities and future trends in nondestructive evaluation and health monitoring based on new sensor principles and advanced microelectronics. It will outline various application examples of monitoring systems based on acoustic techniques and will denote further needs for research and development.

Keywords: structural health monitoring; embedded sensors; advanced electronics; sensor networks