FASERINSTITUT FIBRE BREMEN

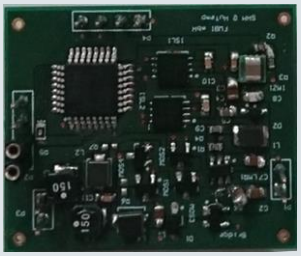
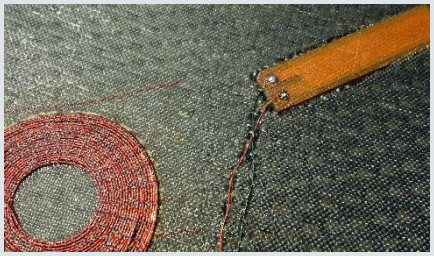
PROJECTS

HuTemp@SHM:
Network of wireless sensors for structural health monitoring of fiber-reinforced composite components via Lamb waves, regarding humidity and temperature

Motivation

Components made of fibre-reinforced composites have become an integral part in many technological fields. Especially aircraft design and automotive manufacturing provide new fields of potential applications. Obviously, detection of damages and, hence, prevention of failures is of tremendous importance. That is why trustworthy methods of structural health monitoring are needed.
Damages in the interior of the component weakening its structural strength and can be detected by guided waves. Unfortunately, temperature as well as moisture influence the wave propagation.

Thus, HuTemp@SHM aims for a **reliable network of wireless sensors for time- and cost-efficient monitoring** and non-destructive testing methods. The project strives to reduce the immobilization time of aircrafts during service. Further, monitoring of components may shorten manufacturing time, minimize production rejects, and make after-production testing redundant.


Electronics of actuator. Embedded antenna with PWAS and battery-less NFC/RFID Temperature Sensing Evaluation.

Research focus and findings

Commonly, piezoelectric wafer active sensors (PWAS) both generate and detect Lamb waves. Accordingly, one applies such PWAS to the components or integrates them during the production process. Typically, sensors connect by wire, which burdens the structure and makes it more complex as well. Hence, we develop simple to integrate patches with electronics that gain power via wireless communication. To include environmental influences into analysis tools, the sensors also transmit information on temperature and moisture. Therefore, we develop robust and low-maintenance electronic devices, which resist weather and heavy usage. Thereby, electro conductive materials as well as errors of the analogous wireless transmission technique are challenging. Finally, we have to keep an eye on the remaining structural strength of device-integrated-components.

Due to the miniaturization of the electronics, waves only propagate for a fixed frequency. This reduces the time interval of data acquisition and simplifies data

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transmission as well. However, due to that known techniques of signal correlation are not suitable for detection and localization of defects. That is why we need to develop new signal processing methods. Actually, pitch-catch methods are in our focus, but we also aim for time-reversal techniques.

A further range of application concerns process monitoring. Therein typically, dielectric sensors measure the effect of curing during the manufacturing process. Using an automated transcription of oscillations of amplitudes of the waves seems to give equivalent results. We strive to supplement these by analysis of period and characteristics of waves.

Possible Applications

Techniques developed in this project are interesting especially in aeronautics, where service under real-world-environmental condidtions completes much faster and, hence, cheaper.
Furthermore, components can be tested whilst manufactured; thus shortening production time and reducing rejects.

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Project Partner

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Faserinstitut Bremen e. V.

The Faserinstitut Bremen e. V. is active in research and development tasks in areas of testing, development and processing of fibres, textile preforms and carbon fibre reinforced plastics. The Measurement Systems and Monitoring department is engaged in the development of measurement systems for assuring the product quality from fibre production via semi-finished fabrics to the final fibre reinforced product.

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