

## ST 10: Prize Talk: Georg-Simon-Ohm-Prize

Time: Thursday 16:30–17:00

Location: PC 203

**Prize Talk**

ST 10.1 Thu 16:30 PC 203

**Ultrasonic Interferometric Procedure for Quantifying Prosthesis Loosening** — ●JAN LÜTZELBERGER — Institute of Sensor and Actuator Technology, Coburg University of Applied Sciences and Arts, Am Hofbräuhaus 1b, 96450 Coburg — Laureate of the Georg-Simon-Ohm-Prize 2024

Loosening of an artificial hip joint is a frequent complication in orthopedics and trauma surgery. Due to a lack of accuracy, conventional diagnostic methods such as projection radiography cannot reliably diagnose loosening in its early stages or detect whether it is associated with the formation of a biofilm in the bone-implant interface.

In this work, we developed an ultrasonic measurement procedure for quantifying the thickness of the layer between bone and prosthesis as

a correlate to loosening. In principle, it also allows for the material characterization of the interface. An analytical model for the reflection of sound waves in a three-layer system was combined with a new data processing method to face the challenges of the specific medical application. By non-linear fitting the theoretical prediction of the model to the actual shape of the reflected sound waves in frequency domain, the thickness of the interlayer can be determined and predictions about its physical properties are possible. The presented approach was successfully applied to idealized test systems and a bone-implant system for thickness determination in the range of approx.  $200\ \mu\text{m}$  to  $2\ \text{mm}$  [1].

The talk will focus on the physical background and the key concepts of the procedure as well as on representative experiments, but also highlight its future potential in medical application.

[1] J. Lützelberger et al., *Sensors* 23, 5942 (2023)