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cea leti

Acoustic Metrology

PATENTS 5 PATENTS

Using acoustic waves to measure mechanical characteristics through metal parts

What it is

This high-precision technology is based on an acoustic sensor integrating piezoelectric transducers that propagate acoustic waves in the structure tested. The transducer's impedance phase spectrum is measured, which allows the observation of frequencies of interest related to the mechanical characteristic being estimated. Data are processed in real time to produce information about the condition of the part being tested.

This very compact system, suitable for integration into clamping, tightening, or other assembly tools, can be positioned very close to the part being tested. This technology is of particular interest for probing metal structures in severe environments characterized by high strain, temperature, or pressure, or in the presence of chemical substances.

What it can do

In a variety of industries, finding the best tradeoff between a structure's weight and its mechanical performance is a challenge. Precision metrology can help optimize the dimension of the structural components without compromising on safety.

This solution can be used to test any critical mechanical system:

- In-line metrology and maintenance of metal structures.
- Assembly verification in the automotive, aeronautics, wind turbine, healthcare, space, and construction industries.
- Force, elongation, deformation, corrosion, and delamination measurement on metal parts, or pressure and temperature changes even in critical and/or difficult-to-access environments.

What makes it unique

Because it creates standing waves in the structure being tested, CEA-Leti's solution is more accurate than conventional time-of-flight techniques. This offers several advantages:

- More accurate and compact than other acoustic solutions
- Very low cost due to the very simple embedded system compared to optical solutions
- Can be integrated into assembly tools, thus reducing total cost of ownership (TCO)

Working with CEA-Leti

Mechanical systems and tool manufacturers seeking solutions to improve their metrology capabilities for structures and metal parts in severe environments can work with CEA-Leti to develop this compact precision measurement technology. CEA-Leti developed a demonstrator for a screw-tightening verification use case. Ongoing CEA-Leti research for the EU SARAH and MOSAIC projects will result in the adaptation of this technology for other kinds of measurements.

Companies of all types and sizes can work with CEA-Leti on projects spanning the entire value chain through single-partner R&D contracts or multi-partner programs. And, with CEA-Leti's "lab-to-market" model, each project is supported until the technology is ready for transfer.

This technology has been transferred to a global specialist in the design and manufacture of assembly solutions for its critical parts metrology needs.

Key figures

- Unsurpassed measurement accuracy of < 1.5% (compared with errors of up to 40% using torque measurement)
- High-speed measurement (1 millisecond)

Scientific publication

Cabanillas, E., et al. (2023). *Ultrasonic Sensor for Pipe Joint Make-up Assessment.* IEEE SENSORS. pp. 01-04, doi: 10.1109/SENSORS56945.2023.10325132.

Interested in this technology?

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