The sixth sense in mechanical engineering: Researchers invent a sensor screw

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An age-old engineering problem: how do you precisely measure the forces that act between two components inside a machine or, for example, on the sail of a boat without drilling holes or sticking on a sensor? Researchers at the Technischen Universität Darmstadt have developed a brilliantly simple solution: a screw with an integrated sensor.

The sensor screw has its origin in special research area SFB 805, "Control of uncertainty in load-carrying mechanical systems" at the TU Darmstadt. If you are investigating uncertainties and ultimately want to overcome them, you need precise measurements that are provided by sensors. "Until now, there really were no particularly good methods for attaching sensors" explains Matthias Brenneis, who invented and developed the screw, based on a previous project at the Institute for Production Engineering and Forming Machines. "Adhesive compounds dissolve easily, especially in a harsh real-world production environment."

In addition, externally mounted sensors provided readings from "outside"; however, these could differ from the forces actually acting in the interior of a machine or a component. "So why not combine a sensor and an machine component such as a screw using metal-forming?" wondered Matthias Brenneis. The advantages are obvious: screws are available practically everywhere and could be replaced by their "sensing" counterparts in entire production chains. Their operation is very simple and the little "measuring device" is hardly prone to faults. The sensor is located exactly where the forces are acting and therefore works very precisely, so that designing and dimensioning can be carried out more

efficiently.

The sensor screw can provide measurement data at certain points in time, but also continuously. Among other things, this makes precise quality controls possible. For example, if a workpiece that is deformed or whose thickness varies is being transported through a roll train, the sensor screws that hold the rollers would register it immediately. Until now, quality-reducing deviations often become apparent only during the final inspection after the entire production process – resulting in expensive rejects.

In order to be able to read and interpret the measurement data of the sensor screw, the TU researchers are developing suitable analysis software. "The goal is to obtain a lot of information from a few reliable data" summarizes Manuel Ludwig, who is in charge of this part of the project.

The screw has passed through several stages, was made smaller, is approaching marketability and has been patented. The German Federal Ministry of Economics and Technology is convinced by the new technology and has incorporated the project in its "Exist-Forschungstransfer" (Exist Research Transfer) program. For 18 months, the development of the sensor screw will now be supported with funding – ideally until it goes into production. The first clients are already using the technology in pioneering projects.

The development of the sensor screw has now culminated in the spin-off of ConSenses GmbH – a good example of the innovation and impetus coming from TU Darmstadt, the "university of originators". But things will not end there, however, explains Jörg Stahlmann, who is in charge of Marketing and Sales at ConSenses. "Our goal for the future is always to cooperate with the TU in order to open up new application fields." The ConSenses founders would also like to benefit from the interdisciplinary

knowledge that converges at the TU. "This pool of expertise can not be found in industry in this form" says Stahlmann.

The TU development turns an everyday object into a smart high-tech product and provides future users with a "sixth sense", as it were, when dealing with buildings and systems. A convincingly simple concept that Matthias Brenneis summarizes with a simple common denominator: "Good ideas are always easy to use."

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