Intelligent connector increases reliability for industry 4.0 and autonomous driving

The reliability of connectors and electrical interconnection technologies are essential for many industrial applications, e.g. in the automotive industry and in the networked production (keyword industry 4.0). Researchers at Fraunhofer EMFT have developed an intelligent connector in cooperation with industrial partners. It monitors the quality of the plug connection by means of miniaturized sensor systems and can thus detect impending failures.

Plug connectors and electric connection technologies play an important role for all mission critical systems. Electrical connectors are essential for secure transmission of data and power in the automotive world. For networked production of tomorrow the connection technologies provide the main interface between the machines, controls and data processing equipment. In the IoT age, the idea is almost inevitable to equip such central nodes with intelligence: integration of intelligent functions enables significant increases in efficiency regarding the reliable operation of plants as well as optimum availability and stability the transmission of data and electrical power in automobiles, e.g. for the fully automated driving.

Even the strictest quality controls and frequent inspections cannot guarantee one hundred percent protection from suddenly occurring defects; degradation phenomena are considered to be the most common failure cause in originally well-tested connectors. Such failures mainly occur on short notice and can cause a total crash of essentially important systems. Degradation in connectors is typically caused by ageing of the used materials, leading to leakages, humidity, creeping currents or power drops. Corrosion and contamination processes can cause the forming of layers with increased resistance on contact surfaces, leading to parasitic resistances. All these phenomena can be electrically measured, which makes it possible to detect and even foresee forthcoming failures in operation.
An intelligent connector with integrated miniaturized electronic sensor systems for monitoring the energy consumption, malfunctions, temperature, etc. could detect the creeping degradation of connectors and thus give evidence about the current quality of the plug contact.

The researchers at Fraunhofer EMFT, together with their industrial partners Erni, Finke, Siemens and Weidmüller, have developed a demonstrator of such an intelligent connector. A miniaturized sensor system integrated directly into the plug connection records the current temperature and current flow, and transmits the measured data wirelessly to a mobile device. This intelligent connector will be displayed during the Electronica trade fair, in hall C5, booth 426 on November 13.-16.

Smart wireless PCB connector, enabling continuous measurement of temperature and current at individual contacts, to acquire data for predictive maintenance. © Fraunhofer EMFT/Bernd Müller