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53rd Internationales Wissenschaftliches Kolloquium
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Contactless sensor measures torque or force

Inductive energy transmission and short range data interface

The goal is to achieve a contactless system for measuring torque or, more common, forces. Currently approaches and practical devices with friction rings are known and used to connect strain gauge sensors and measurement devices. Usually four rings are used to connect ground, power and the two signals of the bridge between the resistance strain gauge and the amplifier. Abrasion and changing resistance due to movement between conducting parts requires maintenance or may even lead to unacceptable electrical properties. To avoid wear on the electrical contacts supplying energy and transporting signals, we have sought to develop a system without these disadvantages.

Parts used in the measurement process are: (1) a strain gauge sensor, (2) an amplifier with filter and (3) interface to further signal processing, often with an AD converter. When using friction rings, they are between (1) and (2). For contactless measurement, energy is required to transmit the signal from the moving to the fixed part. The amplifier (2) and parts of the interface (3) can be combined and mounted on the rotating, or moving, part.

The approach in this research project was applied to inductive power supply combined with a proper signal path.

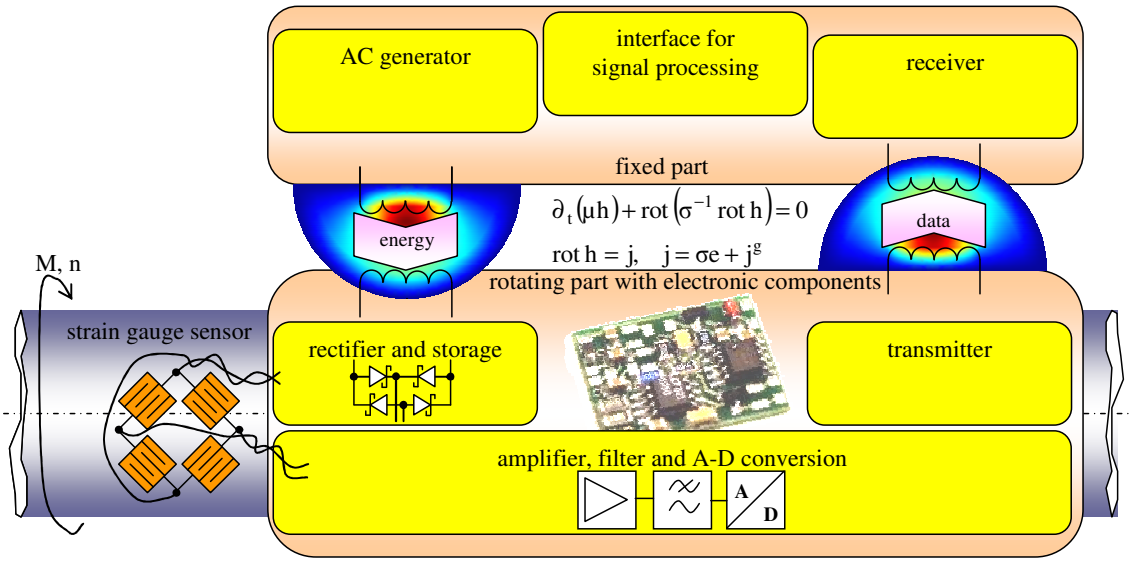

Figure 1 – structure of inductive energy and data transmission

Two inductors are used to supply electrical power to the moving part. They are mounted in such a way as to reach a high coupling of the magnetic flux. The underlying principle is a transformer with loose coupled coils. In comparison to close coupled transformers they have a very high flux leakage. Unfortunately only 10 to 30 per cent of the inducted field reach the secondary coil to induce power. This decreases the efficiency of the whole system. On the other hand, only little power is required to energize the moving or rotating part.

There are several ways of transmitting the measured signal to the fixed part. Table 1 shows some selected options. The most suitable option in any given case depends on details such as bandwidth or data rate, energy consumption and components needed.

Name	**Description**	**Key advantages/dis-advantages, requirements**
Radio frequency transmission	- an electromagnetic field has to be generated, modulated and transmitted using an antenna - on the fixed side a suitable receiver demodulates the signal	- high data rates possible - Interference with other devices possible
RFID	- modulated load on the secondary coil - the receiver recognizes the varying load and demodulates data	- data rate only low percent of operating frequency - only a few additional parts needed
Optical transmission	- serialized data is encoded as infrared pulses - receiver regenerates pulses to digital signal	- no interference if assembled in housing - no electrical emission

Table 1 – various wireless data transmission options

A working system with the opportunity for further research can be demonstrated. Integrated in a motor-driven test station, dynamic properties can be analysed to achieve a practical solution for measurement tasks in test, research, production and real-life applications.

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