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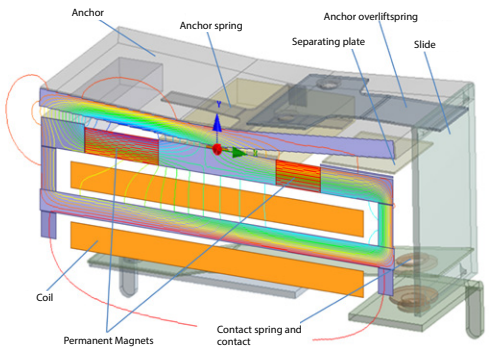
Digital Twin – Simulation in Operation

Remaining life prognosis of a safety critical relay

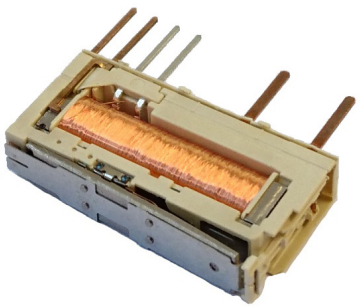


Digital Twin: Failure prognosis through simulation

Real Loads ⇅ Calculated Remaing life prognosis

IoT platform:
Maintenance procedure
Big Data analysis

Sensor data ↑



Simulation of a relay based on measured sensor data

Task

The life of a relay is strongly dependent on its operating conditions. The magnitude of the switched load, the switching frequency and period and the ambient temperature are typical influencing variables. They determine the power dissipation introduced by the electric arc, the resulting contact temperature and wear. In safety critical applications, specialized types of relays show the failure state securely by restraint-guided contacts based on the physical design and the assigned circuit. To predict component failure before it occurs, a simulation model fed by actual load data shall compute the true state. Based on these conditions, this simulation model computes the actual wear of the contacts and the remaining life of the relay system for predictive maintenance.

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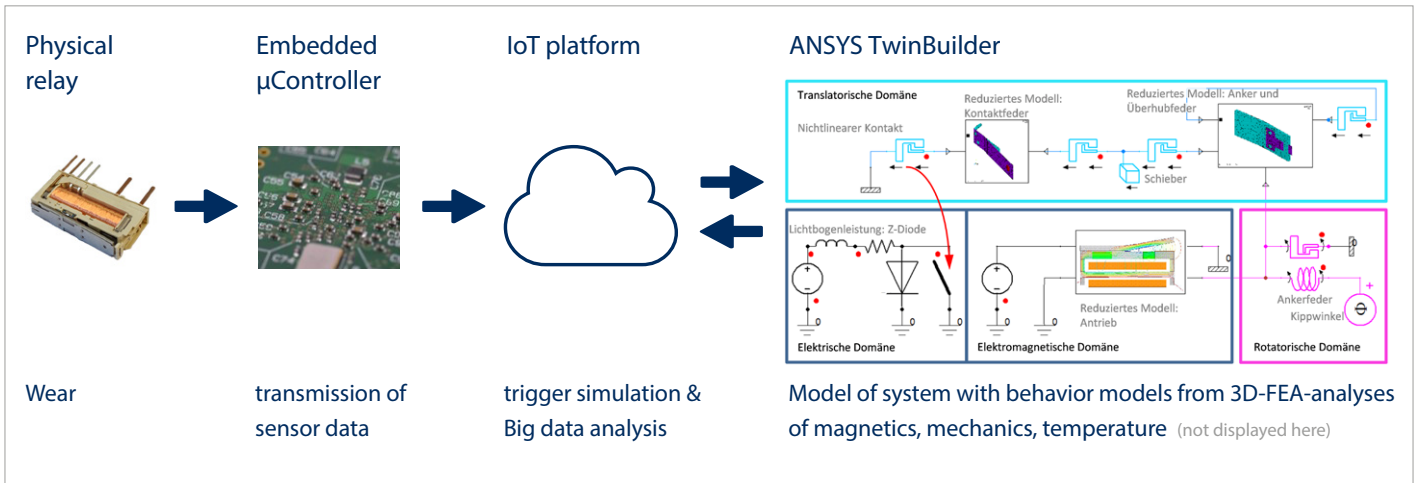
Solution

Simulating the relay in operation requires a model with high performance and truly predictive behavior. The technique of Reduced Order Modeling condenses the results of a detailed 3D finite element simulation to a so called behavioural model or ROM. These ROMs combine speed and accuracy and get connected to 0D/1D elements of the system simulation within ANSYS TwinBuilder. The embedded microcontroller of the physical relay gathers sensor data and sends them to an IoT platform data aggregator. This platform feeds the actual sensor data to the system simulation model, which computes wear and remaining life.

Customer benefit

The Digital Twin enables an analysis and prediction of lifetime relevant characteristics, when real sensors can hardly do the job. The detailed simulation results and the opportunity to get knowledge using virtual sensors – in this case for contact temperature and electric arc energy – are the basis for the real world wear state and remaining life for each individual product. This focus on real-world data instead of paper specs opens the door for a switch from preventive to predictive maintenance. A study of the US Department of Energy has shown an averaged cost reduction of 25% and a reduced downtime of 70%. In addition, these detailed operational data is the basis for an improved next gen product development and new business models.



Technical set-up of a Digital Twin. This project was developed together with Phoenix Contact Electronics.

www.cadfem.de/zwilling

About CADFEM

Founded in 1985, CADFEM is amongst the pioneers of numerical simulation based on Finite-Element-Method (FEM). Since the company's inception, we have been cooperating closely with ANSYS as an ANSYS Elite Channel Partner in Central Europe. Our clients receive everything that is essential for the success of a simulation from one source: software and IT solutions, advice, support, engineering and the transfer of knowledge.