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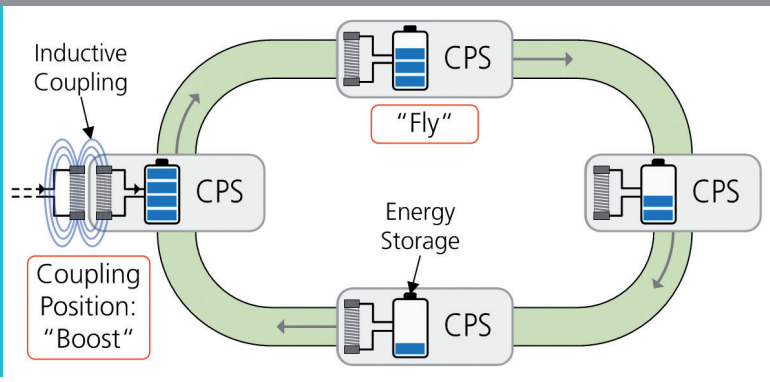

1 *Schematic sketch of the Boost & Fly system (right-hand image)*

BOOST & FLY SYSTEM

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Cyber-physical systems are essential elements of industry 4.0. In the production these systems include physical objects (such as machines, production modules, workpiece carriers, tools etc.) which are equipped with embedded systems. They directly acquire physical data and affect physical processes via actuators. Communications interfaces serve the integration in decentralized control systems and networks and also allow for a real-time synchronization of the physical world with the models of the digital world.
Currently used production plants and machines do not provide the needed interfaces or sensors. Because of high investment costs and the long operating life of these machines, retrofittable solutions are required. Regarding the predicted high amount of sensors and actuators, wire-bound systems reach their technical and economical limits. Wireless solutions are going to stay incomplete, if wireless power supply of these systems is not accessible. Energy sources, such as light energy, thermic or mechanical energy for the transformation into electrical energy ("Energy Harvesting"), are not sufficiently made available.

Fraunhofer IMS has developed a solution for the contactless electrical quick charging ("Boost") of mobile cyber-physical systems and their energy self-sufficient operation ("Fly"). The idea is based on the thesis that cyber-physical systems (CPS) move in deterministic traces in production environments and remain on at least one position for a sufficient time to charge the energy storage ("Boost"), shown in image 1. Then the stored energy can in the following time course supply the system with electrical energy ("Fly") again.

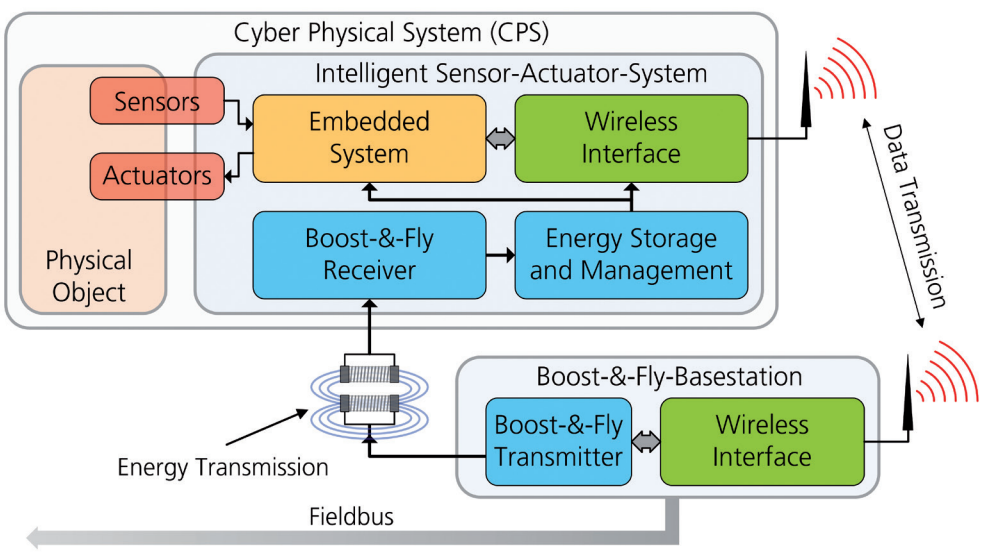

Image 2 illustrates a cyber-physical system with an energy supply based on Boost & Fly. For the transfer of energy an inductive coupling is used between a receiver coil in the Boost&Fly receiver and a transmission coil which can also be part of the base station. During the "Boost" phase the charging of the energy storage takes place. Supercaps are used as storage elements, because they allow for a high charge current as well as a high amount of possible charging cycles. The capacity has been chosen so that the use of the intelligent sensor/actuator can be supplied for in its "Fly" phase.

Properties:

- Self-sufficient operation of cyber-physical systems
- Contactless energy transfer,
- Retrofitting capability (compact design and easy installation)
- High availability and robustness (industrial production environment),
- High efficiency,
- Use of available electronic components on the market

Specifications:

- Inductive energy transmission at 125 kHz
- Operation time ("Fly") up to 7 minutes (@ 50 mW) with a charging time of 2 seconds ("Boost")
- Real-time capable wireless interface
  - 2.4 GHz ISM band (Frequency Hopping)
  - Cycle time: 12 ms
- Demonstrator
  - Acceleration sensor (3 axes)
  - Magnetic field sensor

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2 *Cyber-physical system with Boost & Fly components*