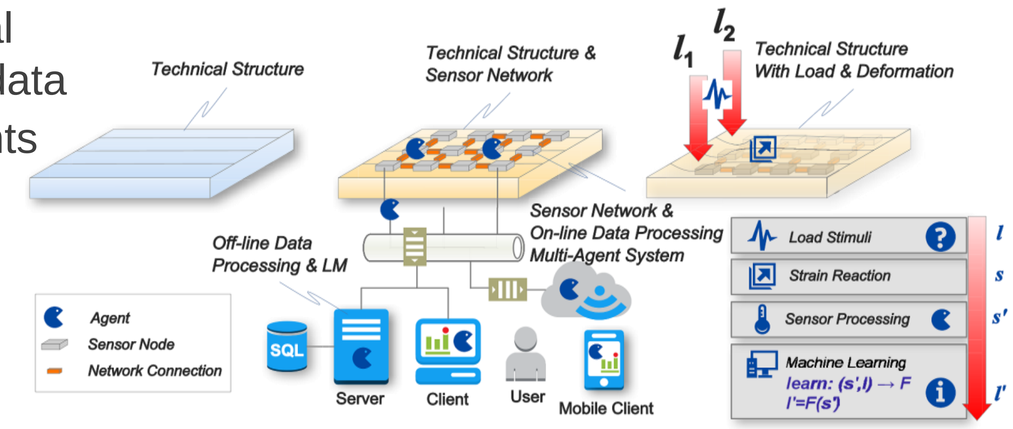
SP4

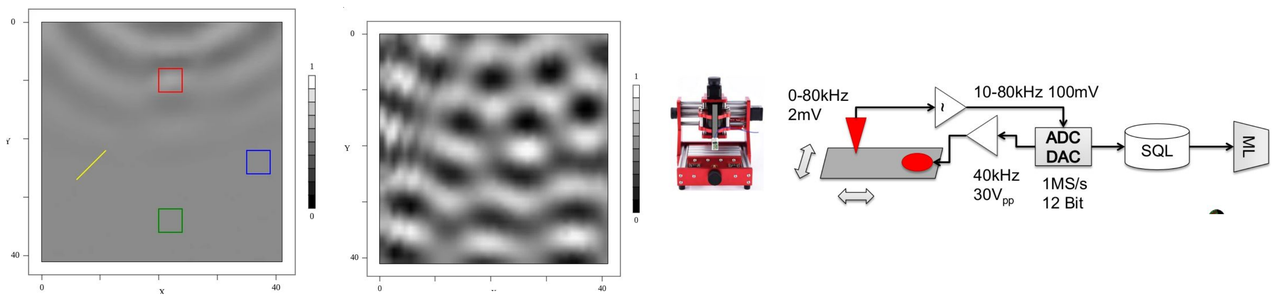
Automatized, model-free damage diagnostics

Prof. Dr. Stefan Bosse | University of Koblenz | Dept. of Computer Science

Most Important Preparatory Work

- Various distributed, non-distributed, incremental and non-incremental **machine learning techniques** applied to high-dimensional sensor data
- **Distributed sensor networks** and processing in real time with agents
- Self-organising **multi-agent** systems for automated ROI detection and **feature selection** in ultrasonic sensor data
- **Integrated transducers** for guided waves in composites
- **Air-coupled ultrasonic techniques** for analysis of guided waves and their individual modes
- **Analytical models** for dispersion, damping properties and excitation of guided waves in composites
- **SHM systems** for composite structures in aviation, wind energy and automotive industry

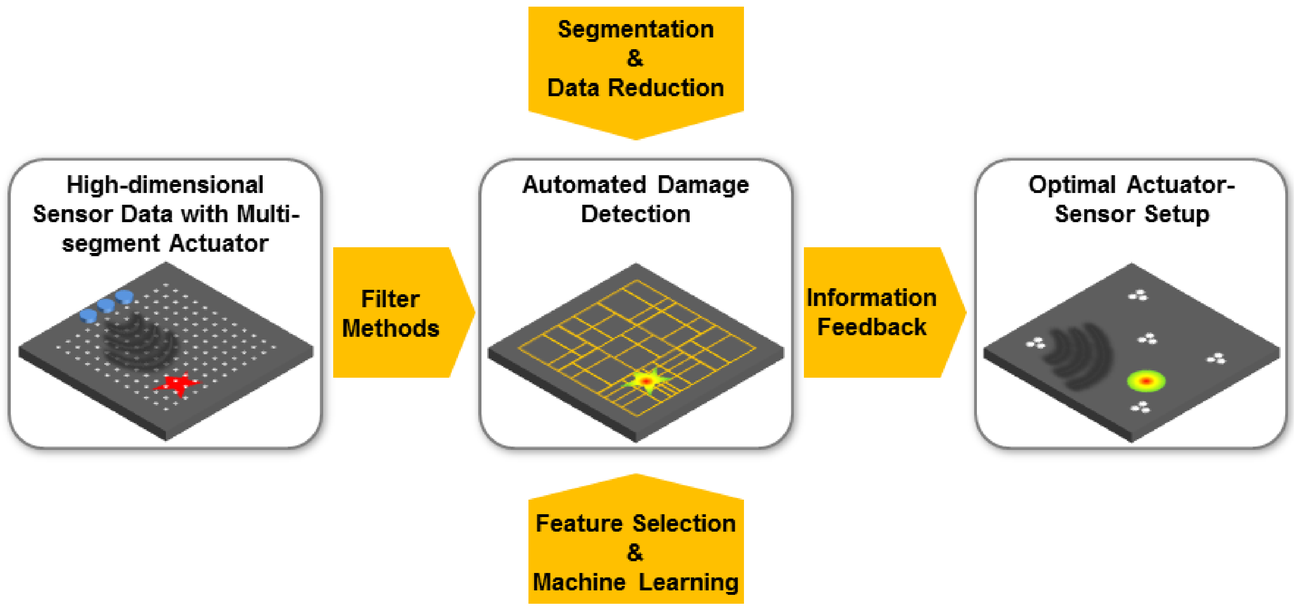




Measured air-coupled acoustic wave field using 2D scanning

Objectives of the first funding period

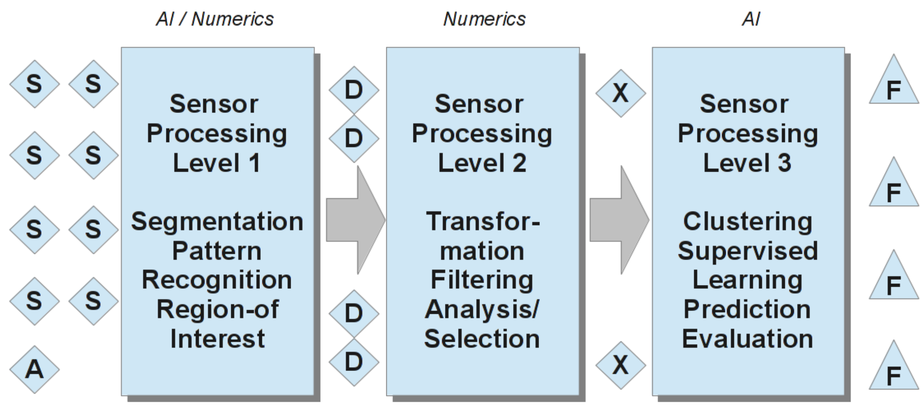
- Amplification of wave interactions with damages by **adapted actuator configuration** and **wave number filter**
- **Reduction of high-dimensional sensor** data by automated and segmented feature selection
- **Automated extraction** of robust damage features by machine learning, agent-based and data mining methods
- **Design rules** of optimal actuator-sensor setup by information feedback of damage features



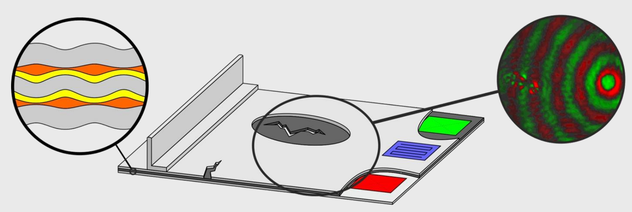
Methods

- **Air-coupled ultrasonic technique** for high amount of data sets with pseudo damages
- **Multi-segment actuators** with phase shifted control for directional, mode selective or almost plane wave fields
- **Wave number and direction selective filters** to identify wave interactions at damages
- Development of **automated segmentation** based on self-organised and self-adaptive pattern recognition

- **Hybrid architectures** of unsupervised and supervised **machine learning** for damage feature extraction
- **Sensitivity analysis** for feedback of damage features to wave interactions and derivation of optimal actuator-sensor setups



Ultrasonic Monitoring of Fibre Metal Laminates Using Integrated Sensors



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