



Source: Oliver Dietze

ZeMA

Centre for Mechatronics and Automation gGmbH
Research Group Measurement Systems
Prof. Dr. Andreas Schütze

Profile: public research inst., ~100 researchers

Research areas:

- Sensors and actuators
- Production systems and automation
- Assembly systems and automation

Strong focus on Industry 4.0, e.g.

- Robotix-Academy (Interreg project)
- Power4Production with DFKI
- **Data-based condition monitoring**

Reference project iCM-Hydraulics (partners DFKI, HYDAC)

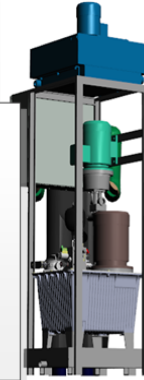
intelligent Condition Monitoring for Hydraulic Systems

Experimental section

Test bench

Process sensors

- Pressure (PS)
- Flow (FS)
- El. Power (EPS)
- Temp. (TS)
- Vibration (VS)
- Virtual sensors



Sensor data stream
~50,000 meas. per
min in total

Approach allows

- Independent identification of various systems faults
- Identification of sensor faults before CM becomes invalid
- Future: online re-training for expansion of fault data base

Target classi

- Const. Offset
- Drift
- Noise
- Signal outliers

Signal
manipulation

Sensor faults

Collected
data

~1,500 features

Feature
extraction

- signal shape
- stat. features

20 features

Feature
selection

- feature-fault
correlation

2 discr. function

Dimension
reduction

- LDA

result

Classification

- k-nearest
neighbor

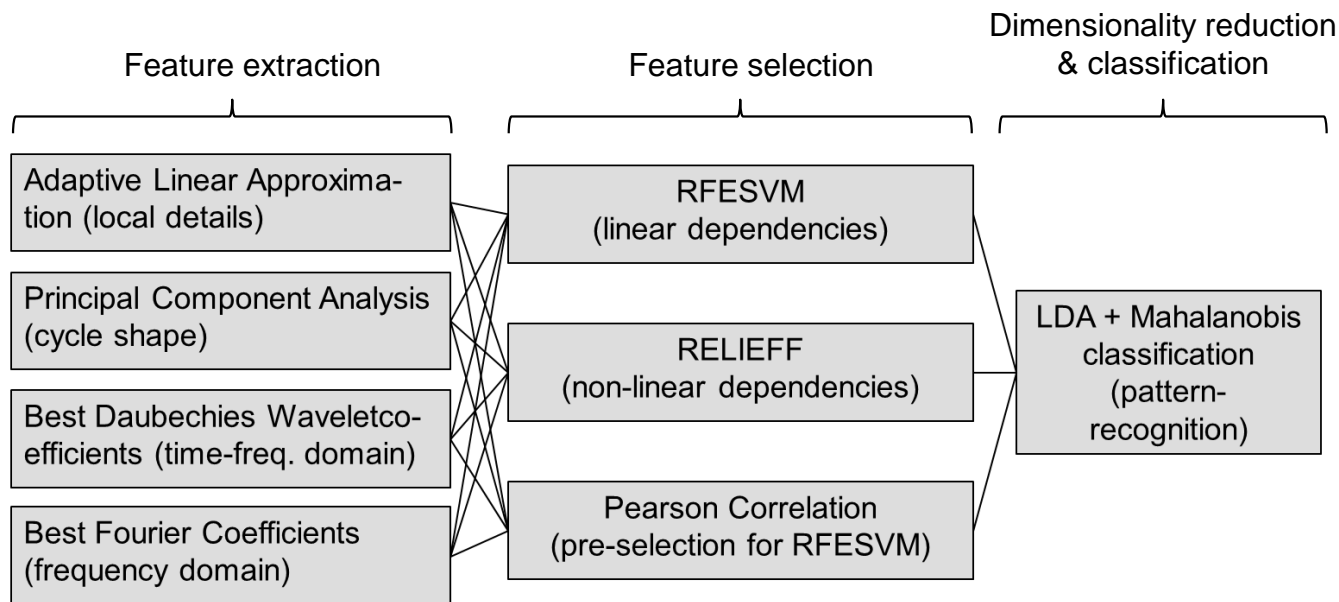
Evaluation

- LOOCV
- k-fold CV

Data section

■ Condition monitoring using statistical data analysis

- Based on previous study using sensor fusion and machine learning techniques
- New: electronic modules for high-speed data acquisition + pre-processing (FPGA, SoC)
- Testbed for electromagnetic cylinders (Festo) with various sensors (xMR current, force, position, rotation, vibration, noise ... - true big data: raw data ~ 1 TB/day)



Fully automated machine learning approach

- Complementary feature extraction, selection and classification algorithms
- Automatic selection of best combination
- Successfully tested with wide range of problems
- Currently expanded for novelty detection



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- **Experienced EU project partner**
- **Strong administrative support (Eurice)**
- **Co-proposer of EMPIR project Met4FoF
“Metrology for the Factory of the Future”
(coordinator PTB, 16 partners)**

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