Theme-based project presentations ARTEMIS Technology Conference 2016

Wednesday 5 October 2016

Time	Project acronym	Theme	Contact	Presentation description
13:30	AF3	Smart Cities	Gabriella Serafino	Smart Fire Forest Fighting
14:00	PaPP	Future CPS	Alexey Syschikov	Portable and Predictable Software Development for Heterogeneous Embedded Manycores
14:30	HARMONIA	Future CPS	Dejan Ničković	Runtime Monitors for CPS
15:30	SYS2SOFT	Future CPS	Patrick Chombart	Multi discipline UAS modelling with combined Safety based approach
16:00	AMASS	Future CPS	Huascar Espinoza	Assurance and Certification of Cyber-Physical Systems
16:30	EnablesS3	Future CPS	Andrea Leitner	Validation of Highly Automated Systems
17:00	CyberMesh	Future CPS	Joonas Elo	Scalable mesh networking and tools for cyber-physical systems
17:30	SMART-FI	Smart Cities	Clara Pezuela	Use and sharing of open data in Smart Cities
18:00	ACCUS	Smart Energy	Ales Tavcar	Efficient optimization for energy management in smart cities

Thursday 6 October 2016

Time	Project acronym	Theme	Contact	Presentation description
9:00	OPTi	Smart Energy	Peter Niermann	Virtualization of large scale DHC networks using a co-simulation approach
9:30	C-DAX	Smart Energy	Matthias Strobbe	Cyber-secure Data And Control Cloud for power grids
10:00	Arrowhead + DEWI	Smart Energy	Mathias Verbeke	Predicting energy consumption: from device to electricity supplier
11:30	IWESLA	Smart Cities	Jaime Mancebo	Improving Water Efficiency and Safety in Living Areas
12:00	SOVITEMP	Smart Cities	Rodolfo Haber	Cyber Physical Systems for Pavement monitoring
13:30	TIMON	Mobility	Giovanni Iovino	Enhanced real time services for an optimized multimodal mobility relying on cooperative net
14:00	IOSENSE	Mobility	Rodolfo Haber	Simulation Model and Verification of Sensors for IoT ecosystems
14:30	AM4G	Manufacturing	Rodolfo Haber	Condition Monitoring for Manufacturing process based on Cyber Physical Systems
15:00	MANTIS & Arrowhead	Manufacturing	Pal Varga	Proactive Maintenance supported by IoT clouds

Condition Monitoring for Manufacturing process based on Cyber Physical Systems

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The AM4G project (2015-2017) is supported by the Spanish government and CDTI.
www.gamhe.eu

ARTEMIS TECHNOLOGY CONFERENCE 2016

Scope of the presentation

I. Introduction. State of the art.

II. S&T challenges.

III. S&T approach to tackle project objectives.

IV. First results.

V. Conclusions

Facts&Figures

AM-4G: "From global information to local decision making for cyber-physical production systems"

Supported by CIEN programme.

2015-2017

Project Coordinator: DANOBAT (plus 7 companies)

Budget: 9.6M€

Center for Automation and Robotics (UPM-CSIC)

13 research groups in the field of Automation and Robotics and about 130 persons devoted to R+D.

www.car.upm-csic.es

Group of advanced Automation of Machines, Highly complex processes and Environments (GAMHE). **www.gamhe.eu**

Recent works in the state of the art [1-6].

Traditional vs Emerging Solutions for Manufacturing

TRADITIONAL

- *ERP SCADA NCS*
- *Remote monitoring &teleop*
- *Local processing (Temp, force, etc.)*
- *External sensors*

EMERGING

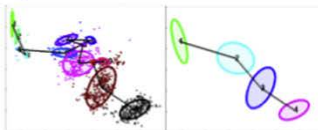
- *CPS*
- *Cloud Computing*
- *IoT*
- *Big Data*

New concepts are focused on self-capacities of manufacturing processes based on CPS paradigm

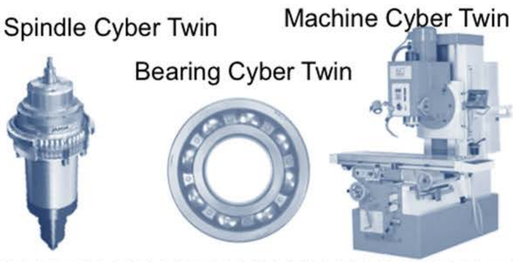
CPS data and information flow for machine tools

III. Cyber Level

- **Adaptive Health Assessment**

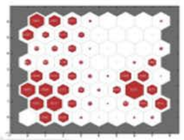


- **Time machine Records**

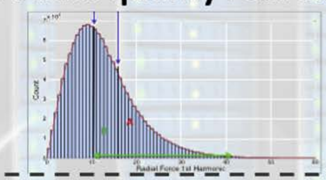


IV. Cognition Level

- **Machine components quality & condition check**



- **Product quality reasoning**



V. Configuration Level

- **Self-Optimized Machine Tool for**
  - **Quality requirements**
  - **Efficiency Requirements**
- **Self-Adjustable Prognostics and Health management**
  - **Advisory suggestions for improving asset life time and product quality**

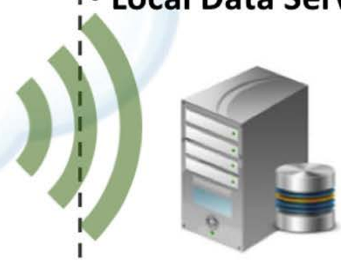
II. Conversion

- **Sensory Data (from critical components) :**
  - **Vibration**
  - **Speed**
  - **...**
- **Machine Level Data (Controller, ...)**

IMS TECHNOLOGIES

I. Connection

- **Local Data Server**



(Bagheri et al., 2015)

Cyber-physical systems (CPS) are smart systems that have cyber technologies, both hardware and software, deeply embedded in and interacting with physical components (Jamshidi,2009).

CPS is an integration of computation with physical processes: composition but also conjunction (**not the union of the physical and the cyber**!).

- ❑Not just large-scale and complex but also characterized by **decentralized, distributed, networked compositions of heterogeneous** and (semi)autonomous elements.
- ❑CPS are **heterogeneous** (many technologies and implementation).
- ❑CPS exhibit **emergent** behaviour (behaviors that are not predictable in advance).
- ❑CPS are **large-scale systems** ("Scale" =logical not necessarily a geographical sense—a system of systems can be a local entity with collocated subsystems).

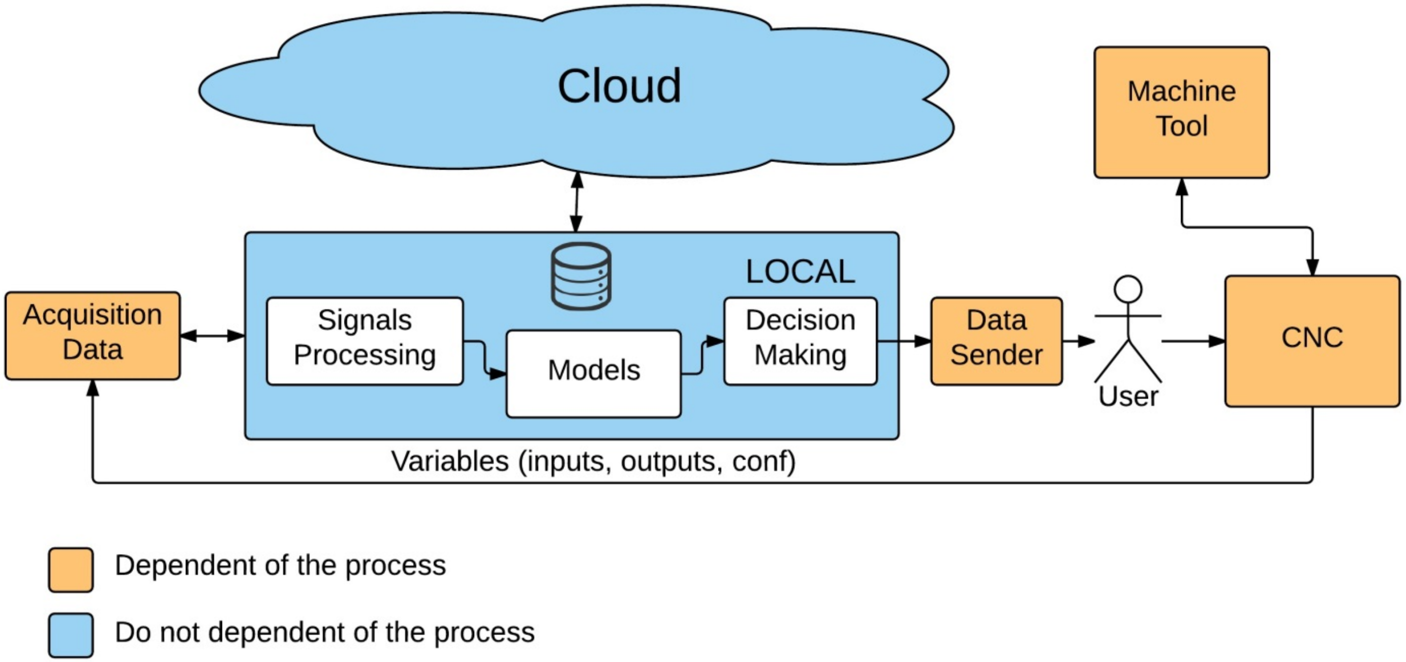
S&T challenges: Fagor –CAR

1. Model-based approach: process and machine condition monitoring by running local models fed by global information (**local mode**).

2. Collect data about the local behavior of the machine/process and all the same family machines (**Big Data&Cloud processing**).

3. Optimization&learning (new models and parameters) in the cloud [4-6].

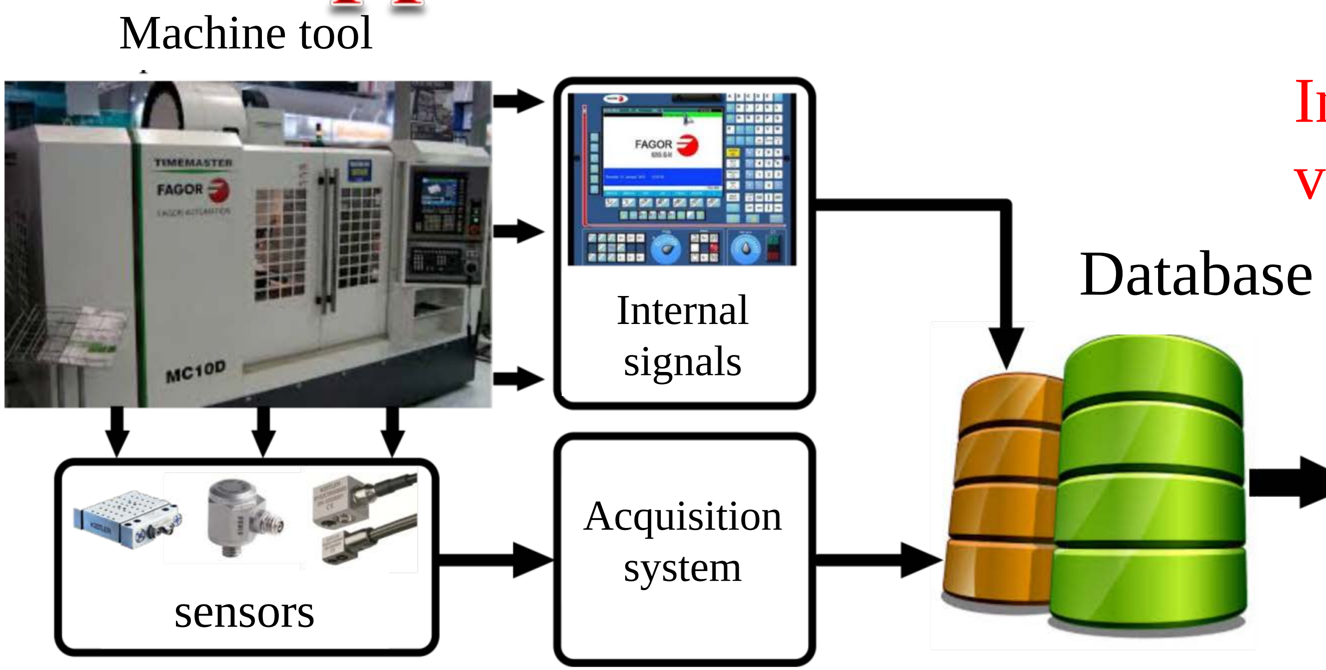
Architecture design



Towards Cognitive Control Architecture&CPS [1-3].

Haber, R.E., et al.. (2015), Artificial cognitive control with self-x capabilities: A case study of a micro-manufacturing process. **Computers in Industry** 74, pp. 135-150.

S&T approach to deal with



Internal PLC/CNC variables

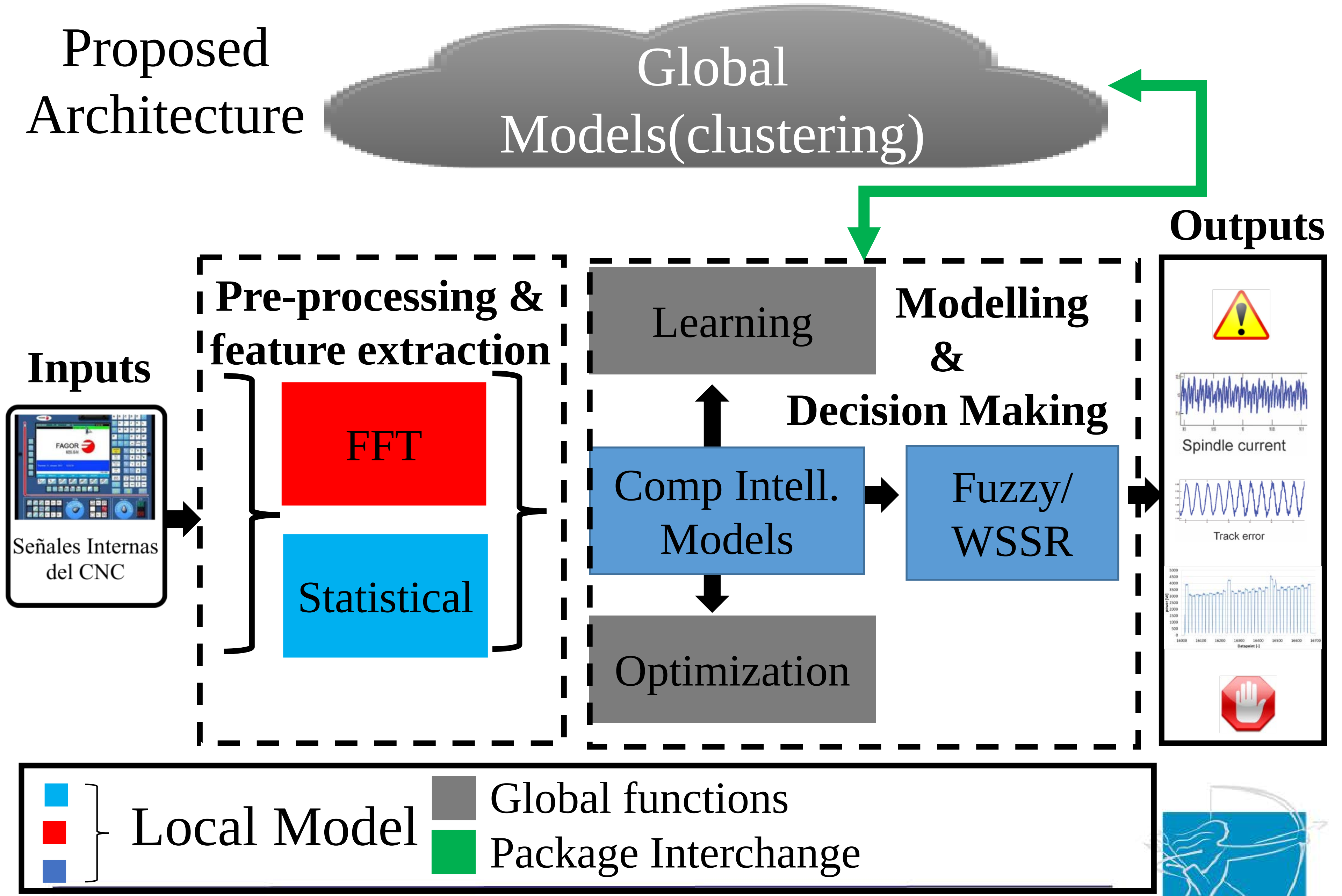
Translation & rotation movement for the different part of the machine tool (Spindle, bearings, etc.)

- Motor power
- Temperature
- Lubricants
- Cycle execution time
- Others …

External Variables (external sensors)

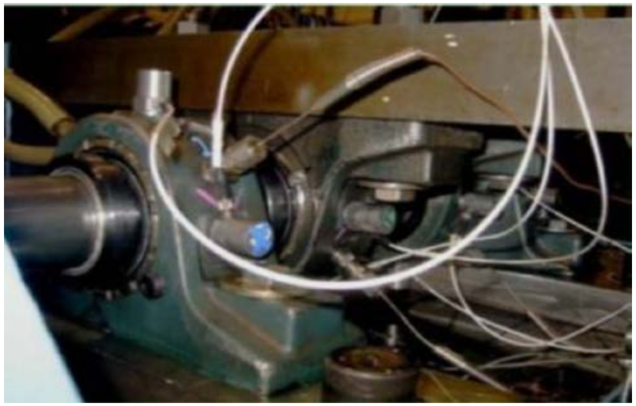
- Cutting forces
- Torque
- Vibrations
- Acoustic emissions
- Current, others.

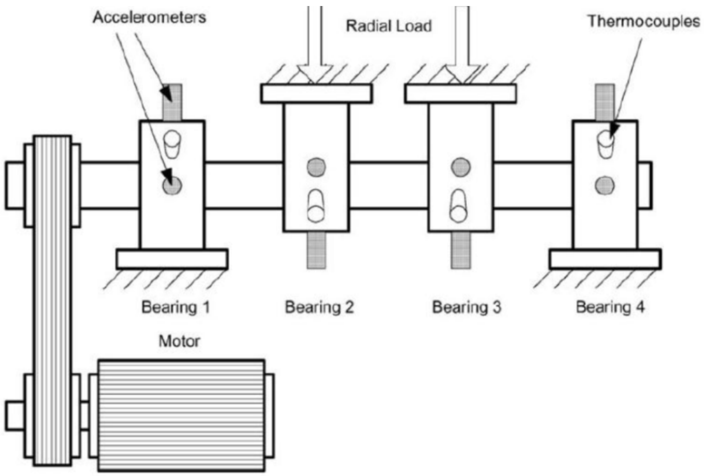
Proposed Architecture

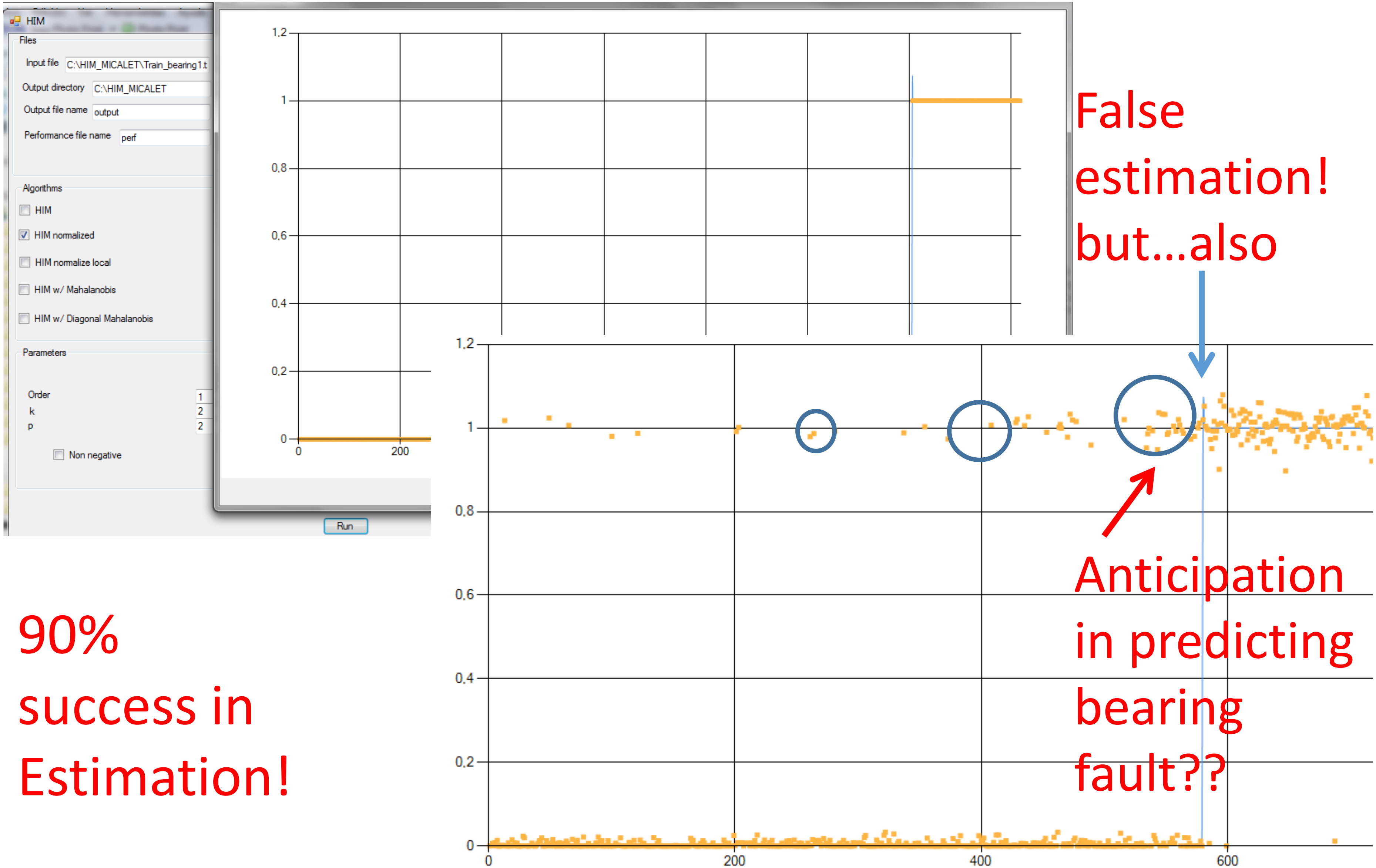


First PoC results. NASA data set

- The proposed method was trained and tested on the bearing data set of NASA (NSF/UCRC). Four bearings were installed on one shaft. The angular velocity was kept constant at 2000 rpm and a 6000 lb radial load.
- On each bearing two accelerometers (one horizontal X and one vertical Y) were installed for a total of 8 accelerometers to register the accelerations generated by the vibrations, where the sampling rate was fixed at 20 kHz.
- Bearing 3 in test 1 is considered failed at the end of its associated history.
- Four condition monitoring data histories related to bearing 2 and 3 in test 1 are used as training set. The monitoring history related to bearing 3 in test 1 is used as test set.





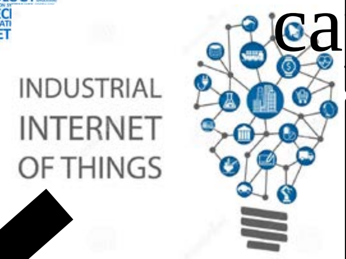


False estimation! but…also

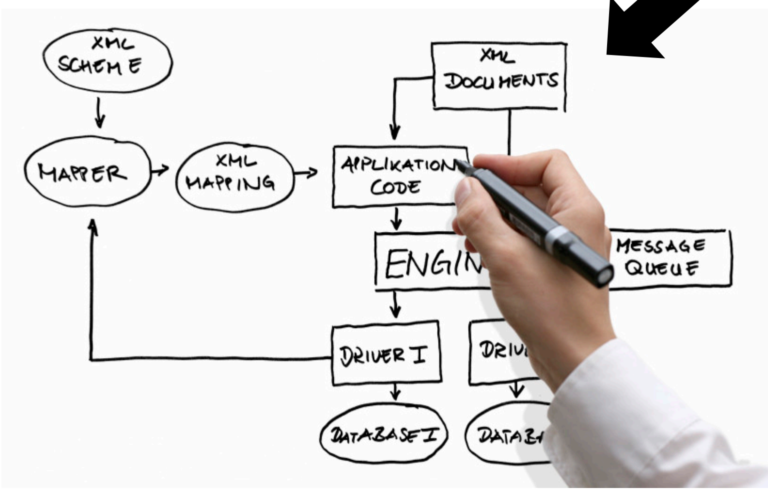
Anticipation in predicting bearing fault??

90% success in Estimation!

Conclusions



Future: self-learning & self-optimization capabilities for industrial IoT and CPS



Industry 4.0 Concepts

References

[1] Haber, R.E.; Juanes, C.; Del Toro, R.; Beruvides, G. Artificial cognitive control with self-x capabilities: A case study of a micro-manufacturing process. Comput. Ind. 2015, 74, doi:10.1016/j.compind.2015.05.001 https://doi.org/10.1016/j.compind.2015.05.001

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