CHIST-ERA Projects Seminar 2022
Big data and process modelling for smart industry (BDSI)

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Introduction: Projects of the Topic

Big data and process modelling for smart industry (BDSI)

- **FIREMAN** *Predictive maintenance in industrial processes empowered by IoT connectivity and Machine Learning*
- **PACMEL** *Process-aware Analytics Support based on Conceptual Models for Event Logs*: process mining, time series analysis, integration of heterogeneous data sources, integration of domain knowledge
- **RadioSense** *Passive sensing for robotic-assisted collaborative industrial spaces*: EM modelling, device-free radio sensing, human-machine interfaces, distributed and federated machine learning
- **SOON** *Social Network of Machines* - smart maintenance for Industry 4.0, multi-agent solutions

Most of the projects of the Call 2017 are already finished.

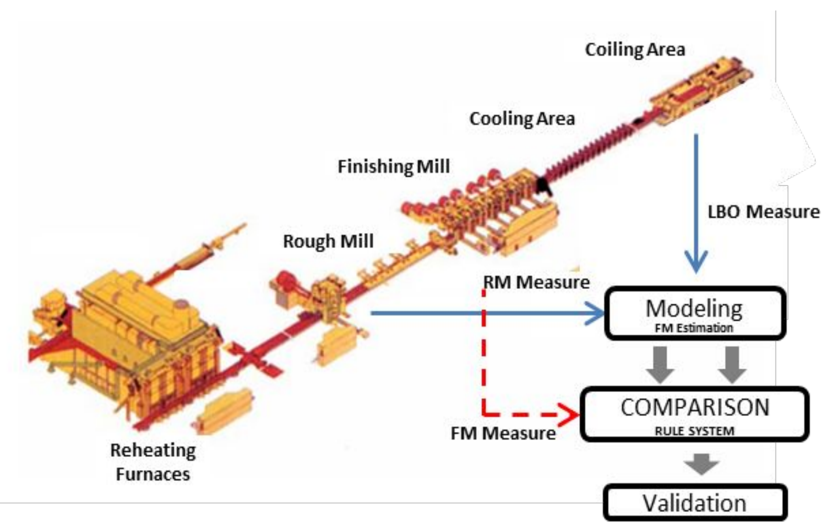
Major Achievements and Outputs - I

Publications

- Int. peer reviewed venues and journals: >120

Demonstrators

- Environmental radio-sensing in an industrial environment (localization, gesture, ranging)
- Failure & asset condition monitoring and detection prototypes (e.g., for grid-forming converters)
- Process simulators and optimization algorithms
- Event-driven sampling in industrial environments (e.g., microgrids) and 5G test networks (5GTN)



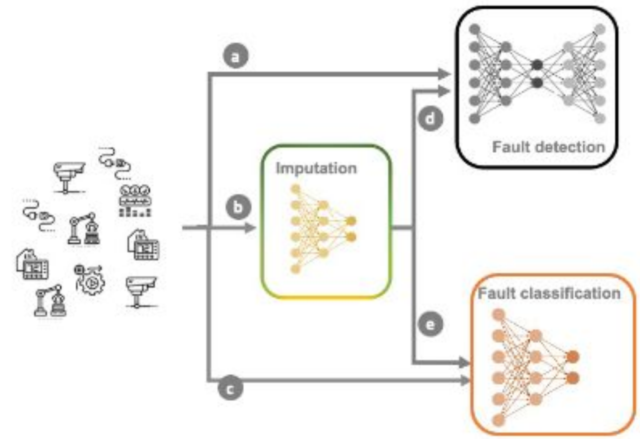
Major Achievements and Outputs - II

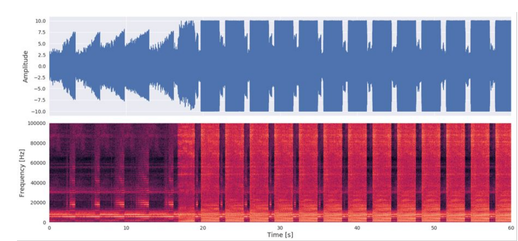
Open source software tools

- Novel ML/AI algorithms (centralized, federated, distributed)
- Open data sets, Open source code (github), and containers (docker)
- Knowledge Augmented Clustering (KnAC)

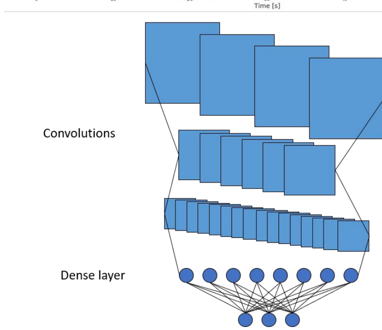
Areas of impact

- Industrial process monitoring, optimization, validation
- Smart/Predictive maintenance
- Environmental monitoring and functional safety
- (Big) data processing
- Beyond-5G industrial connectivity enablers
- Products quality improvement





Signal processing



Convolutional analysis of spectrograms

Upcoming Challenges and Needs - I

Long-term vision

- Keep the human in the loop (HMI-HRI)
- Advances in next-generation networks & industrial connectivity
- New sustainable way of manufacturing through digitization
- Smart manufacturing (robotic assisted) and multi-agent systems

Research methods

- Address limitations of current AI methods (centralized vs. distributed)
- Interpretable/explainable modules for actionable insights and decision-making
- Convergence in cyber-physical system modeling approaches
- Experimental validation of theoretical achievements
- Stream mining with industrial data
- Data and model-driven analysis (statistical, physical/electromagnetic modelling)

Upcoming Challenges and Needs - II

Interdisciplinarity

- Exchange of knowledge among cross-disciplinary teams
- Interplay between industry, academia and business
- Expertise sharing at a transnational level

Results exploitation

- Collaboration in times of social distancing
- Pandemy-related delays impact the schedule of exploitation
- Implementation in the wild
- Experiments at real-world industrial infrastructures (high TRL)
- Follow-up proposals (Horizon EU, EIC transition)

Possible Roadmap

How to achieve the expected impact

- Active participation in standardization efforts
- Interaction with industrial stakeholders
- Collaboration with industrial partners to implement the results

Where to make available the outputs after the project

- Github, Dataport IEEE, Green open access databases
- Project webpages and social media

Potential users of the results

- Maintenance teams, factory owners, network operators, service providers, equipment manufacturers, software developers

How potential users will be contacted

- Networks of project partners
- Dissemination channels
- Open workshops

Role of the CHIST-ERA Support

Reaching the main achievements of the project

- Expanding the scientific research at the European level
- CHIST-ERA personnel very helpful and fast
- Extensions in response to COVID-19 have been possible

Creating added value of implementing the project

- Follow up process provide value to our projects
- Video contest (participation in competitions of 2021 & 2022)
- Support for Future Tech Week Open research seminars (2021, 2020, 2019)

Satisfaction with the international and national implementation

- Yearly CHIST-ERA project meetings good to exchange and collaborate
- Nice that the project size is virtually not limited by single maximum budget
- Topic selection process: very valuable due to alignment with scientific community (academia, industry, funder organizations, …)

Possible improvements

- Coordination of national Agencies: misaligned funding or project start;
  - ✔ Has been improved
- Some countries missing (e.g. Germany, Italy not every year)
- Industrial partners often not funded

Responsible Research & Innovation

Integration of RRI practices in the projects

Consortium agreements describe the treating of some aspects

- Open Science: open data, standardized evaluation platforms, scientific "challenges"
- Science education: Academic courses and theses (BSc/MSc/PhD) on the addressed topics. Organization of training events and special sessions in international conferences. Also, organization of cross-project* workshops.
- Public engagement: Raise public awareness via public webinars. Reach, stimulate and engage a critical mass of relevant stakeholders.
- Ethics: Responsibility towards environment, Discussions started with ethics experts on ethics in environmental sensing
- Governance: Discussion started with stakeholders in industry and TLC sectors

Major hurdles to RRI implementation in the projects

- Industry partners may be fearful of disseminating data and internal process description publicly
- Gender imbalance in ICT
- Limited access to public engagement and talks due to COVID-19 pandemic

*https://soon.umfst.ro/rationality.html

Open Science

Open Science practices

- DMP: implemented by majority of projects
- OA publications: green open access at public, University maintained databases (e.g., aaltodoc.aalto.fi)
- Open data sharing: github, IEEE DataPort*, OpenAIRE, Zenodo***
- Data repositories used: github*, arxiv, Gitlab****, TechRxiv,

Obstacles to cope with good Open Science practices

- Industry reticence to share data
  - ✔ Data sets from industrial partners can sometimes not be shared
- Rules for Open Access funds vary across national funding agencies
- Not all publishers allow gold/green open access
- Academic recognition of other sources of open access different to SCI journals

Costs of implementing the Open Science practices

- Gold Open Access fees can be high (e.g., Elsevier's fee is 2,500 EUR)
- Supporting open data could be costly due to long term maintenance after project completion

*https://github.com/5uperpalo/FIREMAN-project/blob/master/09_PowerConverter_dataset_preprocessing.ipynb

* https://github.com/labRadioVision, DOI: https://dx.doi.org/10.21227/0wmc-hq36

*** https://zenodo.org/record/4459969#.YeEv4IRByh4

**** https://version.aalto.fi/gitlab/salamid1/sidelinkchanneldataset

Technology Transfer

Challenges linked to exploitation, and IPR

- Difficulty transferring to other cases/scenarios
- (Often) Industry is not ready for our solutions! (No data available, no digitalization, etc.)
- Software can’t be patented
  - ✔ Problems in case of disseminating details before patenting

Steps taken towards technology transfer

- Spin-offs:
  - ✔ Towards commercialisation of machine learning-based research via a thorough customer discovery and value proposition.
- Follow up projects at higher TRL
  - ✔ Already started & Novel proposals in the next months
  - ✔ Involvement of industrial partners (SMEs) and policy makers

Tension felt between technology transfer and Open Science

- Industrial, sensitive data

Questions

Big data and process modelling for smart industry (BDSI)

Thank you very much

Questions?

Wireless Big Data Augmented Smart

PACMEL

SOON
Social Network of Machines