CHIST-ERA Projects Seminar 2021

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April 13, 2021
Scientific background

SOON: Social network of machines
Scientific background

- **Context:** Industry 4.0

- **Goal:**
  - Optimization of production flows and processes
  - Reduce impact of failures
  - Design of evaluation benchmark

- **How**
  - Social Multi-Agent System (MAS)
    - Machines, sensors and operators seen as Agents
  - Big data technology and Machine Learning
  - Models for *predictive maintenance*

- **3 applied industrial scenarios**
  - Tooling machines: precision mechanics
  - Recycling industry: plastics recycling
  - Steel-making: wire rod and hot strip mills
Key challenges and potential impact of the project

**Challenges:**
- MAS design
- Predictive and smart maintenance
- Early failure detection
- Efficient failure mitigation (knowledge database)
- Acceptability

**Impacts:**
- Reduction of unplanned production downtime
- Intelligent guide for human operators
- Production lines autonomization
Consortium

4 Academic partners

3 Industrial partners

Universidad de Oviedo
Consortium

HE-Arc (HES-SO) - Project Coordinator
- Data analytics group: AI & Machine learning
- Experience with AI applied to tooling machines processes, predictive maintenance algorithms
- Industrial Partner: Tornos

Institute of Informatics of the Slovak Academy of Sciences
- Research Groups: Parallel and Distributed Computing & Modelling and Control of Discrete Processes
- Expertise: AI, intelligent agents, data collection & aggregation
- Industrial Partner: Mat-Obaly Ltd.

University of Oviedo
- Project Engineering Research Group: multidisciplinary research group (project management / sustainable engineering / data modelling)
- Expertise: process modelling and data analysis for the industrial sector
- Industrial Partner: ArcelorMittal

University of Medicine, Pharmacy, Science and Technology of Târgu Mureș
- Research group: Industrial Informatics, Industrial Processes Modeling and Control
- Expertise: Computational Intelligence, Data Acquisition and Signal Processing
- Involved in Cyber-physical model and testbed development.
Main scientific results, dissemination and other output

**Tornos** is a Swiss machine-tool manufacturer. Tornos uses a range of machining technologies with swarf removal capabilities to produce parts requiring extreme precision and quality.

**MAT-obaly** is a Slovak plastic trading and recycling company. It operates its own LDPE plastic sorting and recycling plant. It’s products are symbolized by high quality and reliability delivered to domestic and foreign partners. It emphasizes environmental protection practices by fair recycling of plastic.

**ArcelorMittal** is the world’s leading steel and mining company. Guided by a philosophy to produce safe, sustainable steel, it is the leading supplier of quality steel products in all major markets including automotive, construction, household appliances and packaging. ArcelorMittal is present in 60 countries and has an industrial footprint in 18 countries.
Main scientific results

- **Requirements** specification & **Scenarios**
- **Multi-agent architecture**
- **Predictive maintenance algorithms** based on social **multi-agents** approach
- **Open dataset** with failure data to share with the scientific community.
- An **evaluation framework** to ensure repeatability and validate the resilience of the proposed approach.
Main scientific results, dissemination and other output

Main scientific results (details)
- Auction approach for maximizing the factory production
- SOON Ontology (Core + 3 Domain Specific Extensions for Use Cases) Social Concepts Ontology
- Machining quality prediction using inertial sensors, acoustic emissions and AI
- Digital Twin for the simulation of rolls replacement process
- Wire rod mill rolls replacement model using a modified asynchronous backtracking algorithm (ABT) approach
- Testbed for electric motor fault detection
- Automatic sensor failure detection algorithm
- Analysis of past maintenance interventions to forecast future needs
- 3-level evaluation framework
Main scientific results, dissemination and other output

Dissemination and other output
- Scientific publications
- MDPI Mathematics - Preparation for special issue
- RATIONALITY International workshop (2020)
  - Workshop 2021 (in organization - want to participate?)
- Consortium creation for a Horizon Europe call loosely based on the SOON project results and ideas
Main scientific results, dissemination and other output

- Iantovics, L.B.; Rotar, C.; Morar, F.: Survey on establishing the optimal number of factors in exploratory factor analysis applied to data mining, Wiley Interdisciplinary Reviews- Data Mining and Knowledge Discovery, 9(2), 2019, e1294.
- Iantovics, L.B. Black-Box-Based Mathematical Modelling of Machine Intelligence Measuring, Mathematics 2021, 9(6), 681.
Valorisation & Exploitation

- Direct exploitation by the Industrial partners
  - ArcelorMittal, Mat-Obaly & Tornos

- Creation of the *Micro-lean lab* in Switzerland
  - [microleanlab.ch/en](http://microleanlab.ch/en)

- Digital Innovation Hubs (participation in progress)

- General public datasets

- Related teaching activities (student projects, etc.)
Thank you!

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Or https://soon-project.eu/contact.html