

Designing Intelligent Manufacturing Systems through Human-Machine Cooperation Principles

Start date : end of 2017 – beginning of 2018 (3 years)

Funding : ANR project - HUMANISM (HUMAN-MACHINES cooperatiON for flexIble production SystemS)

Supervisors :

Co-Phd Supervisor : Damien Trentesaux, Professor M-Pierre Pacaux-Lemoine, Research Engineer LAMIH UMR CNRS 8201 Campus du Mont Houy Université de Valenciennes et du Hainaut Cambrésis 59313 Valenciennes Cedex 11 Email : damien.trentesaux@univ-valenciennes.fr Email : marie-pierre.lemoine@univ-valenciennes.fr Web : http://www.univ-valenciennes.fr/LAMIH/	Co-Phd Supervisor : Christine Chauvin, Professor Lab-STICC UMR CNRS 6285 Centre de Recherche Université de Bretagne-Sud Rue de Saint-Maudé, 56100 Lorient Email : Christine.chauvin@ubs.fr Web : http://www.lab-sticc.fr/
---	---

Registration: Ecole Doctorale Sciences Pour l'Ingénieur Université Lille Nord-de-France

Topic:

The PHD thesis is in line with the problem of Industry 4.0 and the objective to take more into consideration human factors aspects. Indeed, an objective of the factory of the future is to reach a high level of mass customization, low level of energy consumption through more agility of the global manufacturing system. Such a demand implies to design more flexible and more resilient manufacturing system. One way is to involve new technologies from digital and manufacturing technology fields. But at the same time, the Human must be kept at the center of the global process for decision making and supervision. In this context, the project named HUMANISM proposes to use a Human centered design approach. The main idea is to balance Human and technology involvement, taking advantage of automation advances and Human capabilities such as adaptability. But since Intelligent Manufacturing Systems (IMS) are composed of self-organizing entities, one may face emergent behaviors, leading to a source of unexpected and abnormal risky situations.

The PhD thesis will cope with one main HUMANISM objectives, i.e. to develop a methodology to design cooperative assistance systems to support Human awareness and decision making for IMS, as well as assistance systems to control uncertainties. The PhD student will adopt a Human centered approach relying on:

- Cognitive Work Analysis (CWA) proposed by the Lab-STICC. It is considered to be one of the main methods taking human factors into account in the design of sociotechnical systems. This method will here support the design of assistance systems in IMS according to Human current and future needs redefined by new technologies (Chauvin et al. 2015).

- Human-Machine Cooperation principles (HMC) proposed by LAMIH. It provides precise models to identify and implement the best organization and task sharing between Humans and new technologies according to their respective current capabilities and capacities regarding current situation and type of task to perform (Pacaux-Lemoine et al., 2017; Guerin et al., 2012).

To ensure a generic use of the theoretical developments, the method designed within the PhD framework will be applied on three different IMS: a swarm of intelligent products (Fig. 1.a), a cobot system (Fig. 1.b) and a swarm of AGV. These three Artificial Self-Organized Systems (ASO) will be considered regarding the different adaptable or adaptive levels of automation they propose. They differ from each other in the kind of interaction they have with Human, with other machines and in their abilities to reach parts of the objectives of the process.

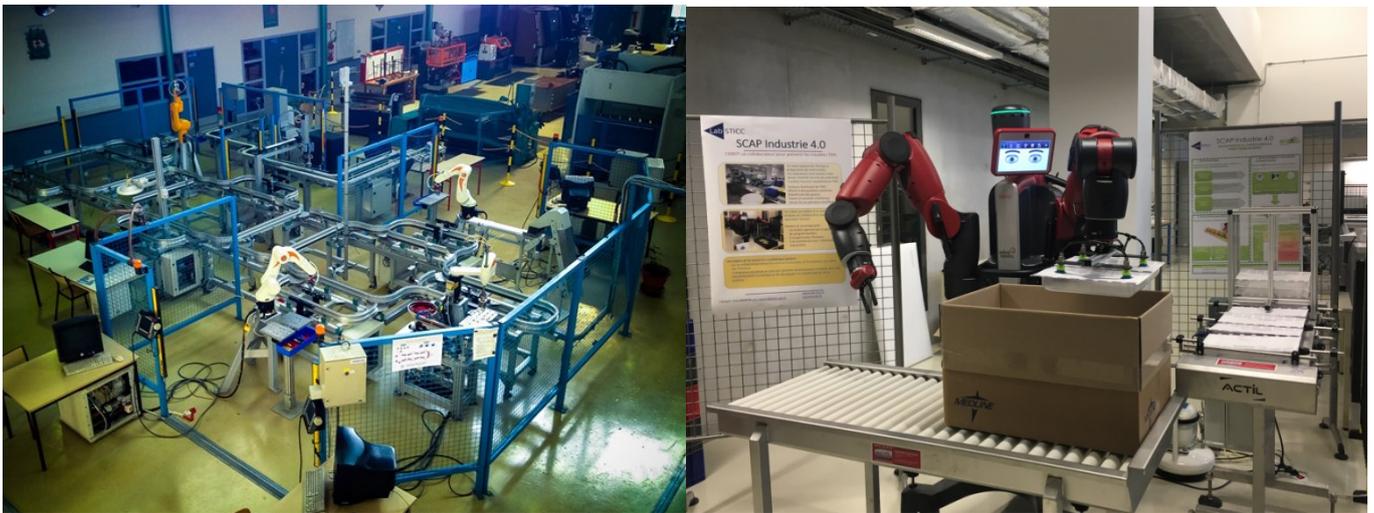


Figure 1: (a) Inter-university Workshop of Production (AIP PRIMECA) of the University of Valenciennes and (b) cobot of the University of South Brittany (Lorient)

The PHD student will be located on Valenciennes University but several trips are to be expected on University of Lorient in order to study and to benefit from the complementarities between CWA and HMC approaches. The result of the combination of both approaches will lead to design and apply a method supporting the identification of the necessary individual and cooperative abilities of Human and ASO, to reach together a common goal. Such identifications will lead to recommendation for the training of Human, the design of IMS and Human-Machine Interface.

The PhD student will also be led to conduct experiments with human operators on the three ASO, available in their real or simulated version in LAMIH and Lab-STICC, to validate the proposed method.

The results stemming from PhD student research will be put as knowledge to be complementarily studied within the context of the SurferLab (www.surferlab.fr), which is a joint academic/industry research lab (UVHC (LAMIH), Bombardier Transport and Prosynt; I-trans, & CNRS labels), working on future innovation for transportation based on distributed intelligence.

Funding:

PhD thesis will be financed during 3 years (ANR funding).

Supervision:

The PhD thesis will be supervised by Prof. Damien Trentesaux (LAMIH, SurferLab; CNU 61), Prof. Christine Chauvin (Lab-STICC; CNU 16) and co-supervised by Marie-Pierre Pacaux-Lemoine (LAMIH).

Skills / Candidate profile:

Candidates must have a strong background in Automation, Industrial manufacturing and knowledge or experiences regarding Human Factors. Candidates must be fluent in English.

Candidature: The candidature file must be composed by:

- One page CV
- Application letter in English revealing the motivation
- Two last years' Master or Engineering school transcripts and class ranking if possible
- Recommendation letter from professors concerned by the PhD thesis topic
- Any documents deemed useful by the candidate

Contact: Marie-Pierre Pacaux-Lemoine, Damien Trentesaux (marie-pierre.lemoine@univ-valenciennes.fr, damien.trentesaux@univ-valenciennes.fr)

Applications must be sent before end of November 2017 to: marie-pierre.lemoine@univ-valenciennes.fr.

References:

Chauvin C., Rauffet P., Tréhin M., Berruet P., Lassalle J. (2015) Using Cognitive Work Analysis to design smart-grid interface, Human Factors and Ergonomics Society, October 14-16, Groningen, The Netherlands.

Pacaux-lemoine M., Trentesaux D., Zambrano rey G., Millot P. (2017). Designing Intelligent Manufacturing Systems through Human-Machine Cooperation Principles: A Human-Centered Approach. Computers & Industrial Engineering, 111, pp. 581-595.

Guerin C., Hoc J.M., Mebarki N. (2012) The nature of expertise in industrial scheduling: strategic and tactical processes, constraint and object management. Int. Journal of Industrial Ergonomics, 42, 457-468.