PhD Thesis Proposal proposed by LCFC Department, Université de Lorraine
Doctoral School IAEM N° 77

Research Department: Laboratoire de Conception Fabrication Commande, EA 4495, Université de Lorraine.

Title: Programming and Control of a Two-Arm Robot for the Handling and Assembly of Flexible Parts and in a Context of Collaborative Tasks.

Title in French: Programmation et Commande d'un Robot à Deux Bras pour la Manipulation et l'Assemblage de Pièces Souples et de Tâches Collaboratives.

PhD Supervisor: Professor Gabriel Abba
Co-supervisors: Associate Prof. Jean-François Antoine, Associate Prof. Patrick Zattarin

Context of the work

This work is part of an INTERREG project to use a collaborative dual-arm robot for the manipulation and the assembly of flexible parts. The flexible parts can be may be cables, wires or fibers. The handling of flexible parts is one of the various application areas. For example, the welding of flexible cables to a connector or the stripping of wires or cables comprising a braid and several wires insulated by a sheath are considered. Another example is the deposition of glass or carbon fibers in dies for reinforcement of molded or forged parts.
In all these tasks, a human operator is in close proximity to the robot either to assist in their realization or to supervise and to qualify the process. In the first place, this proximity leads to security problems which must be managed and controlled. Secondly, collaboration between the operator and the robot must be done in order to guarantee the quality of the work and to improve the overall yield of the production.
The general framework is the future assembly system for Industry 4.0 [1].

Subject description:

The anthropomorphic dual-arm robot control is performed by the manufacturer's programming language. The robot has several proprioceptive and exteroceptive sensors. In order to properly carry out the manipulation tasks of deformable parts (cables, wires), some additional sensors can be used and connected to the control. The collaborative task between the two arms should be seen as a hybrid compliant control problem in position and force in all six directions [2]. Furthermore, the problem of designing a planning algorithm for the dual-arm robotic systems to find paths must be considered. The mimic of the movements of real human is one possible solution to solve this issue [3].
The modification of the control is envisaged via the Ethernet connection called external sensor. This connection makes it possible to modify the trajectory of the robot but also its position thanks to a feedback loop of the sensors.
The major aim of this thesis is to develop and control the anthropomorphic dual-arm in order to fulfill the manipulation tasks and to guaranty the security aspects for human and robot.

References

[1] M. Bortolini, E. Ferrari, M. Gamberi, F. Pilati and M. Faccio, Assembly system design in the Industry 4.0 era: a general framework, IFAC WC 2017, Toulouse, France.
[2] Zollo, L., Siciliano, B., Laschi, C., Teti, G. and Dario, P. An experimental study on compliance control for a redundant personal robot arm. In Robotics and Autonomous Systems (2003), vol. 44, Elsevier, pp. 101-129.
[3] N. Garcia, R. Suarez and J. Rosell, First-Order Synergies for Motion Planning of Anthropomorphic Dual-Arm Robots, IFAC WC 2017, Toulouse, France.

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Candidate Profile

The candidate must have a Master in automatic or robotic. An engineering degree would be appreciated.

To apply, send a **CV, Master scores, any publications and a motivation letter** to:

Gabriel Abba, gabriel.abba@univ-lorraine.fr

Limit date for the application: 2017, September 15

Employer: Université de Lorraine.

More information of the academic partner can be found on:
Website: www.lcfc.fr

Employment contract

Temporary employment contract of 3 years under PhD agreement with the Université de Lorraine

Gross salary: around 24k€ gross annual

Start date: 2017, October 1st or the earliest after that date