

RESEARCH TOPIC FOR THE PARISTECH/CSC PHD PROGRAM

Field: Design, Industrialization

Subfield: Robotic manufacturing, Grinding, Finishing process, Forged workpieces.

Title: Automation of a flexible and agile finishing process of forged workpieces with industrial robots.

ParisTech School: Arts et Métiers Sciences et Technologies

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Research group/Lab: LCFC (<http://lcfc.ensam>)

Lab location: Metz - France

Short description of possible research topics for a PhD:



Grinding is necessary to remove overage parts from forged workpieces (flash, surface imperfections, oxide encrustation, etc.). Finishing processes of forged workpieces are still one manually in most cases. Automation of the finishing process is expected to eliminate the manual operations of high hardness that can lead to musculoskeletal disorders and productivity decrease. Greater accuracy and repeatability of operations is hoped. However, at the end of a forging operation, each piece is unique, and is the image of the accumulation of all process variabilities. The artificial intelligence would be able to control the robot to perform grinding according to observations made on the workpiece. In the meantime, this PhD consists in

creating and deploying a methodology that would allow an effective collaboration between the observation of a workpiece and the interpretation made by an operator and the realization of the expected operations by a robot in a context of industrial productivity. The robot must be able to understand human-like instructions (by gesture, graphics or digital interface). The robotic grinding must also be able to provide a desired geometry or surface roughness despite variations originating from the upstream phases of the process. Robotic grinding has to be able to master the interactions between grinding tool and material, vibrations, robot paths, and forces applied during grinding.

Required background of the student:

Knowledge in robotics, manufacturing (grinding) if possible; computing, applied mechanics

A list of representative publications of the group:

Mohamed DIDI CHAOUI, François LEONARD, Gabriel ABBA – Improving Surface Roughness in Robotic Grinding Process. In: Arakelian V., Wenger P. (eds) ROMANSY 22 – Robot Design, Dynamics and Control. CISM International Centre for Mechanical Sciences (Courses and Lectures), vol 584. 2019. Springer, Cham. Doi:10.1007/978-3-319-78963-7_46

Laurent LANGLOIS, Sandra ZIMMER-CHEVRET, Amarilys BEN ATTAR, Nejah JEMAL, Jonathan HATSCH, Gabriel ABBA, Régis BIGOT -Robotized FSW – Evolution of forces and torque with nonlinear welds - In: 10th International Friction Stir Welding Symposium, China, 2014-05-19 - Proceedings of the 10th IFSWS' 2014 - 2014

Sandra ZIMMER-CHEVRET, Nejah JEMAL, Laurent LANGLOIS, Amarilys BEN ATTAR, Jonathan HATSCH, Gabriel ABBA, Régis BIGOT - FSW process tolerance according to the position and orientation of the tool: requirement for the means of production design – Materials Science Forum - Vol. 783-786, p.1820-1825 – 2014

Jinna QIN, François LEONARD, Gabriel ABBA - Nonlinear Discrete Observer for Flexibility Compensation of Industrial Robots - In: IFAC World Congress 2014, South Africa, 2014-08-24 - Proceedings of IFAC World Congress 2014 – 2014

Sandra ZIMMER-CHEVRET, Laurent LANGLOIS, Julien LAYE, Jean-Claude GOUSSAIN, Patrick MARTIN, Régis BIGOT - Qualification of a robotized Friction Stir Welding System - In: INTERNATIONAL CONFERENCE ON SCIENTIFIC AND TECHNICAL ADVANCES ON FRICTION STIR WELDING AND PROCESSING, France, 2010-01-27 - Proceedings of the FSWP'2010 – 2010