MANAGEMENT AND PRODUCTION ENGINEERING

CIM 4.0 - Advanced, integrated and flexible manufacturing processes through a robotic cell

Funded By	Competence Industry Manufacturing 4.0 S.C. A R.L. [P.iva/CF:12039730010]
Supervisor	SALMI ALESSANDRO - alessandro.salmi@polito.it
Contact	ATZENI ELEONORA - eleonora.atzeni@polito.it SALMI ALESSANDRO - alessandro.salmi@polito.it
Context of the research activity	Additive manufacturing (AM) is recognised as an enabling technology for Industry 4.0. It is a flexible and sustainable technology capable of responding to the challenges of mass customisation. At the forefront of innovation are new integrated multi-process systems that combine several additive and finishing processes in the same machine. These are essentially multi-axis systems, both CNC machines and robotic arms equipped with deposition heads to produce components using directed deposition technology, and welding and/or laser treatment equipment.
Objectives	It is well known that Additive manufacturing (AM) realises digital production: components are produced directly by processing their three-dimensional CAD data, the only prerequisite being the availability of the virtual model. The advantages of AM are many, but one of the most important is the high degree of design freedom. The high degree of geometric complexity that can be achieved makes it possible to optimise materials and shapes for component functionality or to consolidate several parts into one with combined properties. The interest increases when considering AM of metal parts, which has a huge impact on the added value of additive manufacturing. The advent of multi-process systems offers superior advantages over sequential processing by eliminating positioning errors, increasing productivity and improving the quality of the final component. Nevertheless, there are certainly some aspects that require further technical development, such as the programming of deposition and finishing paths with collision detection on added geometries, or the evaluation of efficiency. However, even if we are only at the beginning of exploiting its potential, integrated multi-process production seems to be a very promising innovation. The research activity will be developed at the Competence Industry Manufacturing 4.0 (CIM4.0), in collaboration with the Interdepartmental Center of Integrated Additive Manufacturing at Politecnico di Torino (IAM@PoliTo).

	CIM4.0 intends to be a strategic and operative support to the manufacturing enterprises oriented on the digitization of the industrial processes in the perspective of the Industry 4.0. IAM@PoliTo considers collaborating with industrial partners as a central and strategic vision, to ensure that the knowledge developed in joint projects will be implemented in the industry. The objectives of this PhD are: - to identify the possible applications and products of multi-process systems based on AM, welding and heat treatments, detailing advantages and shortcomings; - to combine numerical tools and DoE experimental approach for the definition of optimal strategies for deposition and finishing; - to analyze the numerical and experimental results and define a series of guidelines for the multi-process operations; - to perform technological and economical assessments of the multi-process systems, including sustainability issues; - to define a methodology for the integration of the multi-process systems with the digital technologies of the Industry 4.0, including digital twin and CAx tools.

Skills and competencies for the development of the activity	The candidate's skills required for this PhD are: - knowledge of Additive manufacturing (AM) technologies, and welding; - knowledge of post-processing and finishing processes for AM parts - knowledge of CAD/CAE/CAM tools; - ability in setting priorities, working in a multicultural and multidisciplinary team, planning the work and respecting deadlines are important; - knowledge of mechanical engineering is welcome together with methodologies for environmental impact assessment.