IT Talks

A SEMINAR SERIES FOR PHD STUDENTS IN INFORMATION TECHNOLOGY

Presentation 1
***Sofia Guerra*: Vision-Based Robust Closed-Loop Control for Quality Optimization in Laser Cutting.**
Laser cutting is a key technology in smart manufacturing, valued for its precision, speed, and flexibility. However, achieving consistent process stability and high-quality cuts remains challenging due to process instabilities, defect formation, and variability across operating conditions. This PhD research focuses on vision-based approaches for robust closed-loop control aimed at optimizing cut quality. The work explores both coaxial and external vision monitoring strategies to extract process-relevant features in real time, enabling early defect detection and adaptive regulation of process parameters. A central contribution is the development of hierarchical closed-loop control architectures designed to minimize single and multiple defect types dynamically. Coaxial monitoring is leveraged for melt-pool analysis, process state classification, and supervisory control of complex cutting trajectories. To enhance industrial applicability, the research also addresses robustness and transferability through domain adaptation strategies, contamination analysis, and auxiliary functionalities such as automatic nozzle centering using NIR coaxial vision. The overall objective is to improve the reliability, adaptability, and quality of laser cutting systems, contributing to the advancement of intelligent and autonomous manufacturing environments.

Presentation 2
***Matteo Moscatelli*: Data-Driven, Learning-Based Approaches for Virtual Sensing and Closed-Loop Regulation of Laser Welding for Smart Manufacturing.**
Laser welding is increasingly adopted in smart manufacturing due to its precision, speed and flexibility, yet accurate path execution remains challenging when dealing with complex seam geometries, positioning errors and part-to-part variability. This PhD research focuses on data-driven and learning-based approaches for virtual sensing, seam tracking and closed-loop trajectory regulation in robotic laser welding. The work investigates vision-based methods to estimate the seam position and relevant spatial features in real time, enabling the system to correct the welding trajectory during execution. In parallel, autonomous trajectory generation strategies are explored to reduce manual programming effort and increase adaptability to different workpieces and seam geometries. The final goal is to improve accuracy and robustness in robotic laser welding, supporting the transition toward more flexible and intelligent manufacturing systems.

Presentation 3
***Federico Porcari*: Explainable AI for Data-Driven Control: An Inverse Optimal Control Approach.**
As data-driven models become increasingly common in control applications, their lack of transparency raises important questions about trust and reliability. This presentation provides a concise outlook on the explainability framework, introducing explanations as a two-step process: first simplifying an opaque model into a useful explanatory representation, and then extracting human-interpretable information from it. The main focus is on the specific challenges of explainability in control systems, where classical XAI methods, typically designed for static, open-loop models, may fail to capture the closed-loop behavior that actually determines controller performance. To address this limitation, the talk presents a control-theoretic approach based on inverse optimal control. By observing closed-loop trajectories generated by an unknown controller, the proposed method interprets the controller's behavior through the lens of an equivalent LQR problem.

Pitch
Guoming Shi, Giuseppe Bavaresco, Gabriele Bianchi.

The event will open with a networking reception.

19th June
11:30 am - 1:00 pm
Emilio Gatti
Conference Room,
Building 20

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