Corso di dottorato: Informatica

Tematica

- “Dottorati e contratti di ricerca su tematiche dell'innovazione”
- “Dottorati su tematiche Green”


Digital Twin for Reengineering Circular and Resilient Production Processes.

The European manufacturing industry is known for its high-quality standards and its resilience. The 2020 Industrial Strategy included a list of actions to support the green and digital transitions of EU industry, many of which have already been adopted or launched. The pandemic has however drastically affected the speed and scale of this transformation. Nonetheless, companies pursuing sustainability and digitalization are more likely to be among tomorrow’s leaders. This transition is aimed at creating sustainable growth and jobs.

The EC and the member states are now aimed at directing this excellence towards the transition to a circular and resilient economy. jobs and upgraded knowledge and skills. This Circular Economy Action Plan provides a future-oriented agenda for achieving a cleaner and more competitive Europe in co-creation with economic actors, consumers, citizens, and civil society organizations. It aims at accelerating the transformational change required by the European Green Deal, while building on circular economy actions implemented since 2015. Circularity is an essential part of a wider transformation of industry towards climate neutrality and long-term competitiveness. It can deliver substantial material savings throughout value chains and production.
processes, generate extra value, and unlock economic opportunities. The goal is reachable at the cost of initial investments that inevitably generate risks. Each time a process or a supply chain is re-engineered certain risks will threaten the project success. This is even more true in today fast changing economical environments in which multiple factors of uncertainty interact. Climate change and pandemics are for example significantly affecting the transport sector with effects on many other sectors such as the raw material supply chain, the real estate market, or the tourism economy. For these reasons, a globally competitive resource-efficient and resilient manufacturing industry requires to advance in the process re-engineering practice to achieve the **full exploitation of the digital twin principle**. We believe today’s challenges require the digital twin to have the capability of representing physical objects in their operative context, i.e., objects in connection to the production process and the supply chain they depend on. This way simulations and training activities on re-engineered procedures can be executed with high accuracy. At the same time, the analytics adopted during the re-engineering cycle must evolve to encompass the full potential of advanced AI methods such as generative models. Data-driven monitoring and re-design methods are traditionally built upon historical data, using parametric statistics. In real-world projects, the availability of reliable historical data cannot be taken for granted, the process may be recently developed, unused or its outcomes are inaccessible. Using generative models and given a training set, we can generate new data with the same statistics as the training set. The proposed research plan is aimed at studying the application of **generative AI techniques** to a digital twin-driven process re-engineering framework aimed at improving the efficiency of the re-engineering process in manufacturing by adopting the ultimate standards in digitalization. The goal is to provide an interpretable model that users can change in order to define “what-if” scenarios, e.g., a what-if scenario where an activity is removed or a new activity is added. The challenges here are: (i) how to integrate the traditional models with generative models; and (ii) how to incorporate the information in a what-if scenario into a generative model. A possible direction to tackle the latter challenge is to adapt existing techniques to incorporate domain knowledge (e.g., the fact that an activity has been deleted) into the output of a generative model.

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**Impresa**

Denominazione: GE Avio S.r.l.

N. mesi da svolgere in impresa (minimo 6 mesi massimo 12 mesi): 12

**Periodo di studio e di ricerca all’estero (facoltativo)**

N. mesi da svolgere all’estero (minimo 6 mesi massimo 12 mesi): non previsto

Indicare se già disponibile la sede di soggiorno all’estero:

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3 https://www.cambridge.org/core/journals/global-sustainability/article/unequal-distribution-of-household-carbon-footprints-in-europe-and-its-link-to-sustainability/F1ED4F705AF1C6C1FCAD477398353DC2