Combined AI and Data solutions for creation of INSIGHTS

Challenge 2.1
Product-production Digital Twins

2 Combined AI and Data solutions for creation of INSIGHTS

2.1 Product-production Digital Twins

Challenge and Context: Traditional design cycle paradigms in manufacturing have been optimised to their limits, and further gains are expected from cross-stage optimisation through combined AI and Data solutions. Digital information is becoming available in large amounts during different stages of product design, manufacturing, useful life, and recycling. Digital twins enable the collection and comprehensive management of all digital information linked to a unique product asset, exploiting it for added value creation within the same stage at which the data was collected. Leveraging these technologies, the manufacturing industry is on the verge of fully reaching Industry 4.0's digitalization potential, where digital twins play a central role at both the product level and at the production level. Manufacturers are striving to reduce their ecological footprints by minimising energy consumption, material use, and waste. AID4SME is committed to overcoming these challenges for use case owners both inside and outside the consortium.

Use Case and Expected Solution: Inside the consortium, Arçelik operates extruder processes to blend virgin plastic material with plastic scrap. Flaws in the mixing rate can lead to discolouration and cracking, generally caused by high ratios of recycled material. Arçelik seeks a product-production digital twin solution to optimise material mixing ratios based on real-time measurement of visual and mechanical properties of the different plastic source materials. This aims to increase the ratio of recycled plastic, enhancing sustainability while maintaining quality and reducing scrap. Additionally, Arçelik's consumer electronics refurbishing factory, which refurbishes over 50000 products annually, seeks to reduce the amount of refurbished products by combining augmented sensing (cf. challenge 1.1) and a product-production Digital Twin to optimise End-of-Life Product Refurbishment processes by assessing the health and predicting the remaining lifespan of components. For this industrial high-TRL application, Arçelik has foreseen the following activities/Key Performance Indicators (KPIs): (i) improvement of existing sensors and integration of new ones in the extruder machine; (ii) integration of visual, dimensional (width, length, thickness) and mechanical quality control systems into the existing extruder machine; (iii) creation of a digital twin of the developed system; (iv) determination and control of optimal process parameters (screw, speed, mold and barrel temperatures, gear pump pressure, cooling water temperatures, material mixing ratios, etc.) using AI and data analysis; (v) reduction in maintenance costs, waste rates, and energy consumption; (vi) 5% increase (1200 tons) in recycled plastic content in Arçelik refrigerator products; (vii) resolving 95% of quality control issues; (viii) reduction in virgin material usage. This list is not exhaustive but rather indicative. Additional KPIs will be studied and can be integrated to ensure quality outcomes.

Besides this high-TRL application, KU Leuven has technology blocks available at TRL 4 and low-TRL playgrounds, namely a fully equipped injection moulding laboratory facility, to develop and test related solutions. This allows to link the manufacturing process to product quality in mecha(tro)nic applications. For application on the low-TRL research lab playgrounds, the focus will be on the technological development of a dedicated product-production simulation framework for injection moulding manufacturing processes.

Call for SME Application Projects: SMEs are invited to propose a use case leveraging their own technology or solving their problems at hand, which will be further elaborated together with the consortium partners. Inspirational examples can be based on system identification, quality control, process parameter optimisation, etc. The consortium offers low-TRL research lab playgrounds as well as one high-TRL industrial application (as detailed above). SMEs applying for this challenge should specify which TRL level they would like to target. For the industrial application, the consortium partners will guide and mentor SMEs to deploy a straight-through digitalization (STD) approach in the challenges. More specifically for this challenge, a product-production digital twin for their extruder processes for blending virgin and regrind plastic and masterbatch materials will be developed and demonstrated at TRL 6 at the high-TRL playground of Arçelik.

Funded by the European Union

Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or European Health and Digital Executive Agency (HADEA). Neither the European Union nor the granting authority can be held responsible for them.