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AI Tools For Condition Evaluation And Anomaly Detection

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Artificial intelligence (AI) is one of the trendy technological innovations. Having the ability to emulate human intelligence, it provides the capability to process vast amounts of data and aid in decision-making processes. The usefulness of AI has multiple viewpoints: automation and efficiency of complex calculations, predictive analytics, adaptability and ability to learn in a continuous manner, personalization of the offer of products and services, virtual assistants, multi-purpose optimizers, etc. Many tools have been developed to implement AI, such as TensorFlow, PyTorch and Scikit-Learn.

According to Gartner (Gartner, 2023), organizations that operationalize AI transparency, trust and security will see their AI models achieve a 50% improvement in terms of adoption, business goals and user acceptance by 2026. It is expected to have a great impact across various industries, such as healthcare, finance, manufacturing, supply chain, retail, education, and so on. Machinery industry is one of the multiple potential targets for the expansion of AI. It should be highlighted that recent advances in this industry are oriented to the improvement of the overall efficiency of equipment and predictive maintenance, (Matyas et al., 2017). However, the lack of data in certain scenarios and the lack of expertise in such domains, especially in small and medium enterprises (SMEs), implies that the success of the application of these technologies is still low.

This paper presents two solutions that cover the aforementioned gaps: the AIDEAS Condition Evaluator (**AI**$^{\mathbf{CE}}$) and the AIDEAS Anomaly Detector (**AI**$^{\mathbf{AD}}$). The former is a toolkit for determining the condition of a machine as a whole or of some of its components when it is in working conditions in the factory where it is being used, whereas the latter is a toolkit that allows detecting anomalies at component-level or of the machine as a whole when it is in working conditions in the factory where it is being used (AIDEAS, 2023). The **AI**$^{\mathbf{CE}}$ and the **AI**$^{\mathbf{AD}}$ have a user-friendly user interface that allows non-experienced personnel to apply complex algorithms and processes in a simple and intuitive way. Both solutions have a similar structure:

- a configuration phase in terms of information about the machine allowing to define its components and related variables for each of them (see Figure 1). This configuration can be saved and afterwards loaded for faster use;
- a connection to databases where data of the machines are stored in order to feed the solutions. Data can be visualized in tabular and graphical form;
- a training phase for the AI algorithms, where the trained model can be saved for later use;
- and an execution phase of the models built in the previous phase. A non-experienced user would in general be using only this final part of the solutions where the configuration and the model have already been defined and trained by other users.

The toolkits allow training and using different kinds of AI models such as neural networks, k^{th} nearest neighbors, etc. depending on the particular application (Zhang et al., 2022).

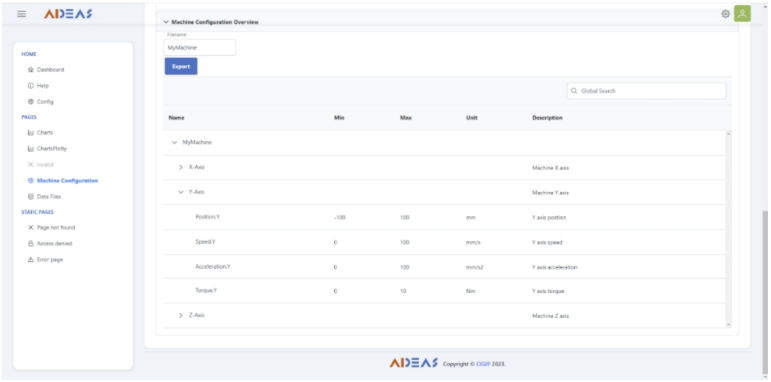

Fig. 1. Configuration view of the solutions.

The AI^{CE} and AI^{AD} solutions are developed in the framework of the AIDEAS project (Cordis, 2022), abbreviation of "AI Driven industrial Equipment product life cycle boosting Agility, Sustainability and resilience". This project proposes the development of 4 Suites composed by 15 Solutions, which will allow benefiting from AI technologies applied to the entire industrial equipment life cycle. Each suite refers to a stage of the life cycle of equipment: design, manufacturing, use and the combination of repair, reuse and recycle (see Figure 2). Specifically, the AI^{CE} and AI^{AD} solutions belong to the use suite, which adds value for the industrial equipment user, providing enhanced support for installation and initial calibration, production, and quality assurance for working on optimal conditions. The suite also includes other 3 solutions, called Machine Calibrator, Adaptive Controller and Quality Assurance.

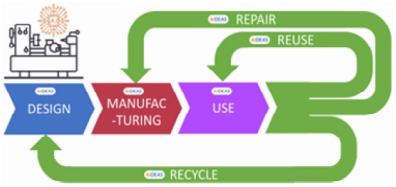

Fig. 2. AIDEAS life cycle.

The validation of these solutions will be carried out in 3 of the 4 pilots of the project. Thus, the applicability and the usefulness of the solutions will be demonstrated in cutting machines, machining centres and blow moulding machines.

Acknowledgements

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