PROJECT PROGRESS

Machine Learning micro-services APIs

RETROFEED is an EU-funded project that aims at boosting the use of increasingly variable, bio-based and circular feedstock in process industries by retrofitting core equipment and implementing an advanced monitoring and control system, while also providing support to operators through a decision support system (DSS) covering the complete production chain. The RETROFEED approach is being demonstrated in six industries from five Resource and Energy Intensive Industries (REII) sectors, namely ceramics, cement, aluminium, steel, and agrochemicals.

Following this line, one of the main goals of RETROFEED is to increase the knowledge of REII processes by deploying advanced modelling techniques at different stages of the production chain. Therefore, three main advanced modelling techniques are explored within the project, including Machine Learning (ML), Digital Twins (DT) and optimization models. At this moment, within RETROFEED project, a detailed description of all the modelling techniques in each demo-case, the software requirements needed for its deployment and use and the overall API architecture within the DSS have already been defined. Specifically, six ML models have already been developed for the demo-cases, addressing the quality, efficiency, and emissions of the production chain:

- In TORRECID, an ML model was developed to assess the final emissions of the process. In addition, a recipe switching model, a quenching system model, and a DT of the furnace will complete the smart framework of this demo-case.

- In SECIL, the ML model aims to evaluate the secondary air temperature in the cooling system in order to optimize the overall efficiency of the process. A fuel mix model and a DT of the kiln have also been developed and will be included in the DSS for this demo-site.

- In ASAS, an ML model to assess the quality of aluminium products based on the feedstock was developed. The DSS will also include a raw material selection model and a DT.

- In FERRIERE-NORD, two ML models were developed. First, a quality ML evaluates the final quality of the steelmaking products based on the input materials. Second, an efficiency ML model evaluates the energy efficiency of the process considering the temperature of a specific panel in the cooling system. The smart framework will also include a scrap and fuel mix selection model and a DT of the furnace.

- In SILCOTUB, an ML model to evaluate the composition of the slag (percentage of FeO) was developed. The DSS will also include a raw material selection model and a DT of the furnace.

Overall, the preliminary results obtained show great potential for supporting plant operators and opening new paths for smart and circular strategies in the different industrial processes. The collection of data is still ongoing and new improvements and optimizations of the models are expected in the next months. In addition, all these modelling techniques will be deployed and tested in the DSS in future months to be further evaluated in real industrial scenarios that will facilitate assessing the best retrofitting options and operation plan of the processes to achieve a high impact over the whole production chain towards a circular economy approach.

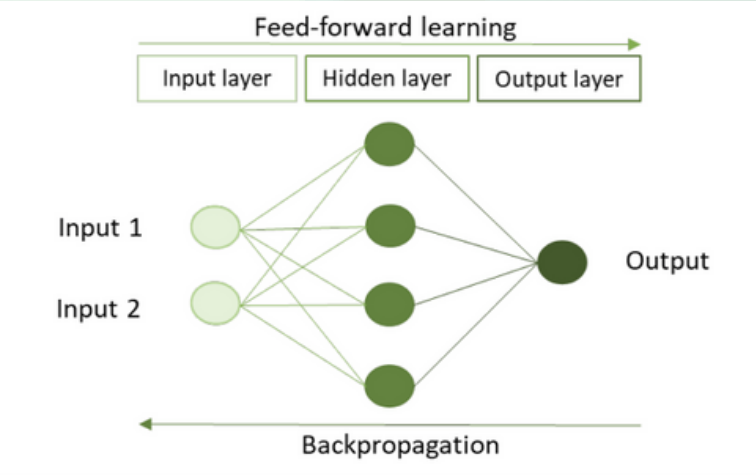

Figure.1 Exemplary Machine Learning model consisting of an input layer with 2 inputs, 1-hidden layer with 4 neurons, and an output layer with 1 output

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement N.869939