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Application of Deep Learning technique to improve the scrap quality

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In recent years, the exploitation of Deep Learning and computer vision to classify waste material has rapidly increased to automate recycling processes, increasing efficiency and reducing carbon footprint. Electric steelworks, which produce steel by recycling ferrous scrap, fit perfectly into this context. In effect, the identification and classification of different types of scrap is strategic to improve efficiency in steel production, promote implementation of Circular Economy principles and reduce CO2 emissions. In particular, to enhance the recycling of low-quality scrap material, it is fundamental to reduce the presence of impurities such as tramp elements (e.g. copper). Currently, scrap characterization and monitoring are still manually carried out, based on subjective assessment based on operators'experience. Therefore, the application of Deep Learning techniques for steel scrap classification is crucial to improve scrap recycling and exemplary shows that AI can be profitably applied in the metallurgical field to automatically assess the grade of each scrap piece.
In the present work, a Deep Learning model for the automatic detection and identification of the presence of copper in scrap is described. The created dataset consists of scrap images collected with the camera during the Horizon Europe Clean Steel Partnership project entitled "Purity improvement of scrap metal"(Ref. PURESCRAP - G.A. 101092168). The images, obtained in the test campaigns conducted at Stena Recycling facility, were labelled and exploited to train, validate and test the model. In particular, two models were developed based on the FasterRCNN + ResetX-101 architecture and YOLOv11 architecture, and their performances were compared.

Primary authors: PETRUCCIANI, Alice (Scuola Superiore Sant'Anna); Prof. COLLA, Valentina (Scuola Superiore Sant'Anna); Dr VANNUCCI, Marco (Scuola Superiore Sant'Anna); SIDDIQUE, Arslan (Scuola Superiore Sant'Anna); OMETTO, Marco (Danieli Automation S.p.A.); MENEGHIN, Mauro (Danieli Automation S.p.A.); PIETROSANTI, Costanzo (Danieli Automation S.p.A.)

Presenter: PETRUCCIANI, Alice (Scuola Superiore Sant'Anna)

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