Contribution ID: **138** Type: **Oral Presentation**

Computer Vision-Based Copper Detection for Electric Arc Furnace Scrap Quality Enhancement

Monday 11 May 2026 14:50 (20 minutes)

The ongoing digital revolution across industrial sectors has positioned Deep Learning and Computer Vision as pivotal technologies for transforming conventional operations, particularly in waste management and material recycling. This transformation holds significant implications for Electric Arc Furnace steel production, where scrap metal serves as the principal feedstock. The efficiency and environmental performance of Electric Arc Furnace operations heavily depend on the characteristics of incoming scrap materials. Accurate categorization and assessment of various scrap grades are essential for enhancing furnace operations, reducing ecological footprint, and advancing Circular Economy objectives.

A critical bottleneck exists in enhancing lower-quality scrap streams through the detection and removal of contaminants, particularly copper, a process that currently depends on subjective manual evaluation and operator expertise.

This research describes the creation and assessment of an automated Deep Learning system for copper identification in ferrous scrap materials. The investigation forms part of the project entitled "Purity Improvement of Scrap Metal" (PURESCRAP, Grant Agreement 101092168), which is funded by the European Union through the Horizon Europe programme and is focused on maximizing the utilization of inferior scrap categories through implementation of advanced technological solutions for contaminant reduction.

A custom image dataset was assembled from photographs captured during on-site testing phases at scrap processing facilities. All images underwent meticulous manual annotation to mark copper presence and spatial coordinates, establishing the reference data required for training and validating the detection models. The research involved implementing and comparing two cutting-edge object detection frameworks to determine their effectiveness in this application.

The deployment of such automated detection systems addresses multiple operational challenges simultaneously. By replacing human visual inspection with machine learning algorithms, the approach offers consistent, rapid, and scalable contaminant identification. This technological advancement supports the steel industry's transition toward more sustainable practices by enabling better utilization of secondary raw materials that would otherwise be considered unsuitable for high-quality steel production. The outcomes contribute to both economic efficiency and environmental responsibility in steel manufacturing, demonstrating how artificial intelligence can facilitate industrial sustainability goals while maintaining production standards and reducing dependency on virgin materials.

Speaker Country

Italy

Speaker Company/University

Scuola Superiore Sant'Anna, Pisa

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

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

Session Classification: Automation and Digitalization in Electric Steelmaking I

Track Classification: EEC 3 - Materials and Raw Materials: EEC 3.A Sourcing and quality of scrap metal