**Graduation project at Tata Steel Nederland**

**Reducing energy consumption and CO2 emissions by applying a digital twin in the thermal management of torpedo ladle cars**

**Tata Steel in the Netherlands (TSN) is committed to reduce** its CO2 emissions with 35 - 40% by 2030 and being CO2-neutral by 2045. Therefore, projects to achieve more (energy) efficient production, monitor the process and increase the quality will lead to a major effective steelmaking and assist TSN in reaching its emission targets.

Steel production is a complex and energy-intensive process. Applying advanced digital tools can support the optimization of the entire production route by enabling better and faster decision-making, improving installation performance and increasing energy efficiency.

One of the production steps susceptible to significant energy losses, involves the transport of molten iron (pig iron) in so-called torpedo ladle cars. A digital twin with an artificial intelligence system can enhance multifactorial analysis, allowing energy efficiency improvement in the pig iron transport. A digital twin is a virtual representation of a physical object. The twin can be based on historical production data, sensor information, simulation models, or a combination of them. A digital twin based on so-called reduced order modeling (ROM) can be used to simulate the thermal state of the torpedo car and thus its energy losses. ROM is a technique to reduce the computation complexity of, e.g., finite element models (FEM). It significantly reduces the computation time while preserving the accuracy.

**This research internship aims to develop a ROM-based digital twin to simulate the thermal management of torpedo ladle cars and applying advanced digital tools to** select the most energetically favourable torpedo car. The research activities in this assignment include:

* Develop a ROM for the torpedo using available FEM simulation data, e.g. via physics-based machine learning in Python
* Develop in Python a digital twin based on the ROM
* Validate model with FEM simulations and compare against commercially available digital twin software
* Write report with conclusions on feasibility

Duration: approx. 9 months.

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