Master Project

Slag Basicity Control under Ambiguity in HIsarna

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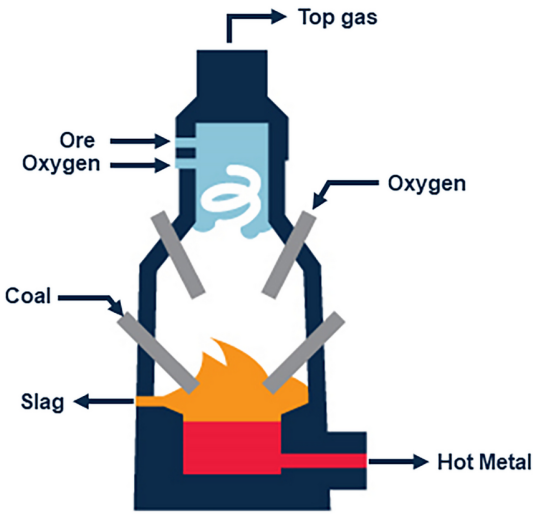
Context

The steel industry is one of the largest emitters of greenhouse gases. Therefore, there is a need to develop revolutionary sustainable methods for producing iron and steel. HIsarna is one such sustainable method developed by TATA Steel Europe for a long time. Due to the flexibility offered by this iron-making process which allows using unprocessed iron ore, it is a promising technology. Currently, work is going on to stabilize and optimize this iron-making method.



One of the steps of that process is maintaining the optimal level of slag in terms of its chemical composition. It is important to regulate the slag basicity to preserve the quality of iron produced. This is where the concept of distributional robust control comes into use, as the fluctuations in the slag basicity are random and we wish to control under imperfect knowledge of the distribution of these disturbances.

The existing controller (from previous work done on HIsarna) is implemented on the real system. This controller outperformed human operators in a simulation environment which motivates this step. While the existing controller was trained in a simulation environment, the uncertainty in the real system may be different from that of the simulator. Using actual measurements together with more sophisticated training may lead to a controller that can handle various material properties

and operating ranges appearing more common in production. Therefore, using techniques from distributional robust control improves the robustness and performance of the controller.

Project tasks

This master thesis project is aimed at developing the most suitable control rule based on distributional robust control using a simulation environment:

1. Implement the previously developed optimal control table and compare it with the human operators by TATA Steel.
2. Apply distributional robust control with Tata Steel's in-house simulator to improve the robustness and performance of the controller.
3. Improve data acquisition of measured input signals to enable more accurate and reliable simulations.
4. Develop a visualization system that suggests the consequences of following the optimal policy or human operator.

This master thesis project is done in cooperation with TATA Steel Europe, department of HIsarna Pilot Plant. The algorithm will be designed and validated experimentally.