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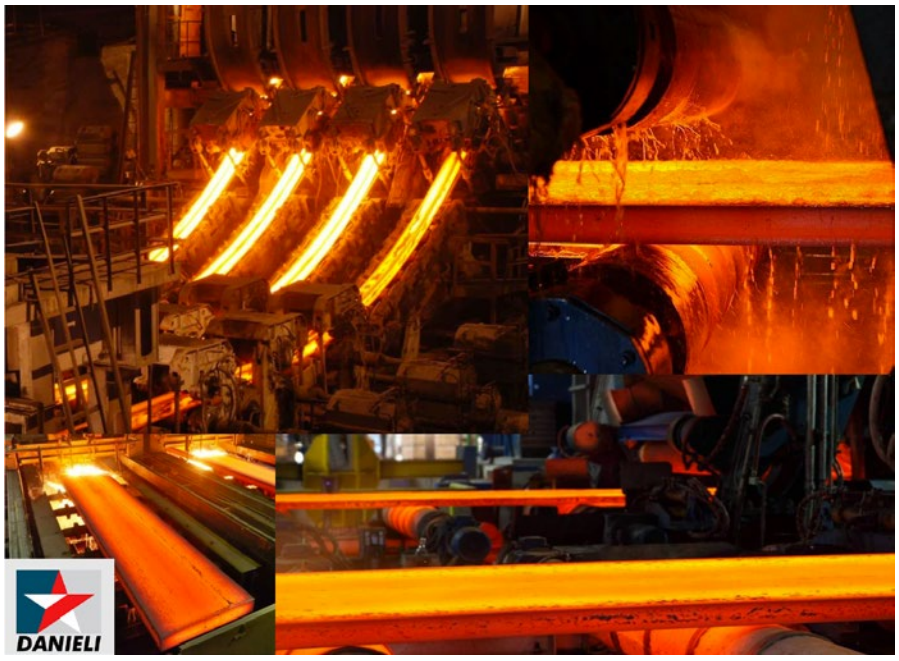
Monitoring Tool for Steel Continuous Casting Mold.



Overview of the different machineries involved in the continous casting process.

PROBLEM DESCRIPTION

To properly monitor a continuous casting mold, to know the mold-steel heat flux is crucial. This quantity is not measurable directly, so the objective of this project was to estimate it given some pointwise temperature measurements provided by thermocouples located in the interior of the mold plates.

CHALLENGES AND GOALS

This data assimilation problem comes under the category of inverse problems. As such, it is an ill-posed problem that requires regularization techniques for its solution. In general, these techniques are very computationally expensive but, being this a monitoring problem, we require the estimation of the mold-steel heat flux in real-time.

Then, the goal of this project is to develop novel methodologies meet the real-time requirement of the project.

MATHEMATICAL AND COMPUTATIONAL METHODS

We can divide this problem in three phases: modelling the heat transfer in the mold, solve the data assimilation problem, and achieve real-time performances. In modelling the mold, we had the mold plates as computational domain and a heat conduction model. For the estimation of the heat flux, we used a deterministic, optimal control framework. In this framework, we exploited a parameterization of the sought heat flux with the objective of reducing the computational costs and regularize the problem. Finally, to achieve real-time performances, we developed novel model order reduction techniques.

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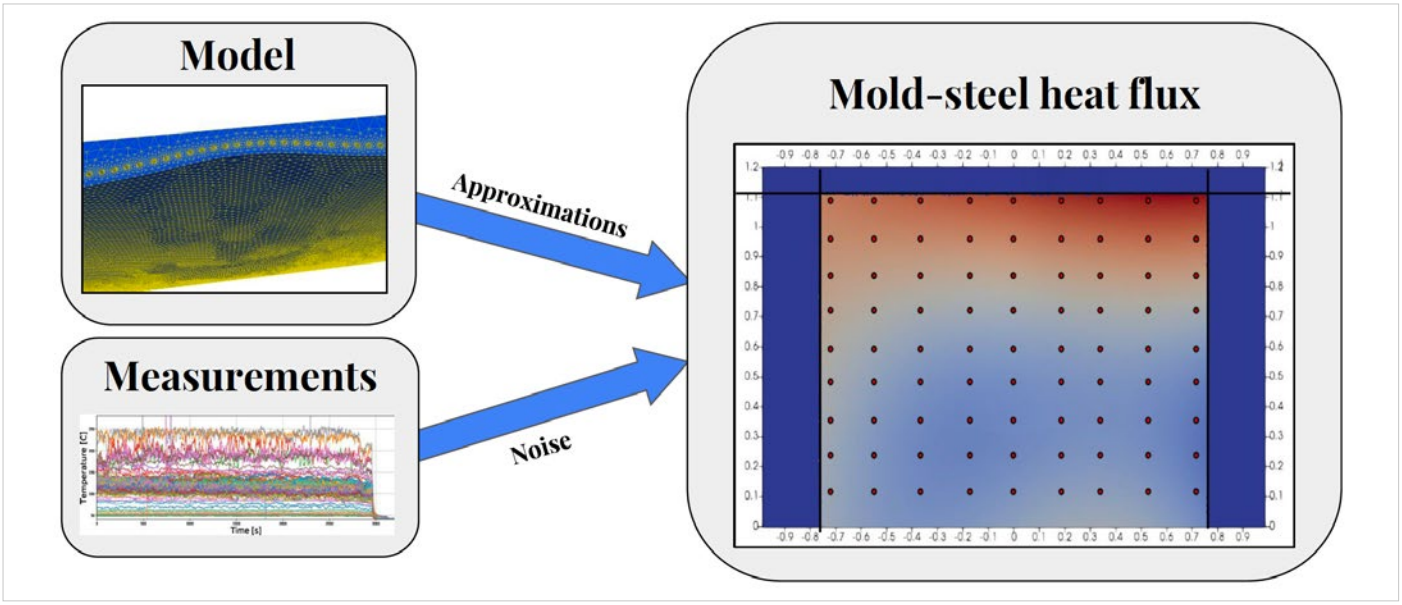

Schematic of the data assimilation process.

RESULTS AND BENEFITS

We equipped the company with a mathematical tool that provides excellent estimations of the mold-steel heat flux in réal-time. This real-time estimation allows a fast detection of dangerous casting issues and the monitoring of the genera mold behaviour. Finally, unlike all previous methods, the developed one does not rely on the caster operator experience and can be applied on any mold geometry.

The developed methodologies provide a reliable tool for the monitoring of the mold behaviour. It makes a fast and accurate detection of any casting issue increasing safety, productivity, and quality of steel continuous casters.