Press Release

July 2022

Temperature Soft Sensor for steel semi-products

The CAPRI steel use case belongs to the production of long products, so called billets. They are produced by means of a casting machine in which the hot liquid steel is transformed to solid semi-products with square cross sections. In the next process step the billets are re-heated and rolled to round bars. For this process a couple of temperature measurements of the steel surface are made by means of pyrometers, installed at fixed locations in the rolling mill, and the present soft sensor enhances those by interpolating the temperature evolution for intervals where no measurements are available. After rolling the cooling and especially the detailed temperature development is of interest. Because there are no further temperature measurements devices, this is done by a 2D- temperature model.

Input of the temperature model are first the contour of the steel bar and second some cooling parameters. The result of the temperature model is a cooling curve and furthermore 2D-temperature information. The 2D- model is realized with FEM- analysis and uses partial differential equations for the heat transfer.

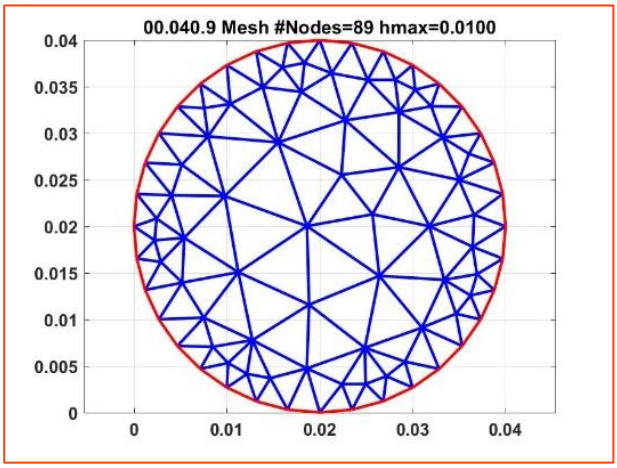

Figure 1: 2D-mesh for round steel products

First step in modelling is to create the contours of the products. In Sidenor plant there are round profiles with diameters from 30 millimeters up to 100 millimeters.

For each round contour, a FEM mesh is generated (see Figure 1). The size of the mesh triangles has to be small enough to contain appropriate information, and big enough to guarantee a low calculation time. Additionally, boundary conditions, as material parameters are set.

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Second step of modelling is the creation of model calibration information. This concerns functions for the heat transfer coefficient. For later use and other environment conditions it is possible to calibrate this model input with real measured information.

The run of the temperature model will create templates for later use. The model is applied for each diameter from 30 millimeters to 100 millimeters. The input of the model is the mesh, the boundary conditions, the heat transfer coefficient functions, and additionally a start temperature. As start temperature 1100 degrees Celsius were chosen, because this is the highest temperature possible after rolling. The model simulates a time span of 150 minutes, the timestep is variable, for example 30 seconds.

The result of the model run are a 1D-cooling curve and 2D-temperature distribution per timestep (see Figure 2). These results are stored in the database and are templates for later use.

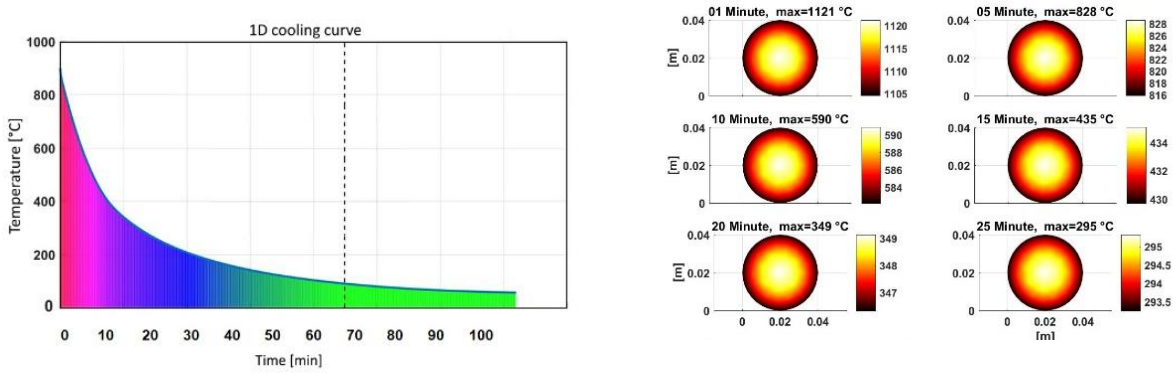

Figure 2: 1D (left) and 2D (right) cooling curves for different timesteps

About the project

Project Full Name: **C**ognitive **A**utomation Platform for European **PR**ocess **I**ndustry digital transformation

Project ID: 870062

Start Date: 01/04/2020

CAPRI (www.capri-project.com) is a 42-month H2020 project that brings cognitive solutions to the Process Industry by developing, testing, and experimenting an innovative Cognitive Automation Platform (CAP) towards the Digital Transformation. To achieve that, CAPRI enables cognitive tools that provide existing process industries flexibility of operation, improving the performance across different indicators (KPIs) and state of the art quality control of its products and intermediate flows.

Three main technical objectives enabled by the development, testing and experimentation of an innovative Cognitive Automation Platform (CAP) for three use cases from process industry (asphalt, pharmaceutical tablets and steel billets and bars manufacturing), are being pursued:

- **Process Industry Digital Transformation & Automation** through digital technologies like data collection, storage, and knowledge extraction to provide detailed insights into process control and resource availability.

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- **Improved performance and flexibility in the process industry** via digitalisation of process industries to dramatically accelerate change in resource management, improve their performance and flexibility and in the design and the deployment of disruptive new business models.
- **Next generation process industry plans** for their autonomous operation of plants based on embedded cognitive reasoning, while relying on high-level supervisory control as well as providing support for optimised human-driven decision-making.

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