

High Performance Computing for Profile Extrusion

Organizations

Soprefa is a Portuguese SME specialized in the production and distribution of plastic profiles for a large variety of applications.

Wolf Dynamics is an Italian SME specialized in consulting services in computer-aided engineering (CAE), multi-physics simulations, numerical optimization, data analytics, and interactive data visualization.

University of Minho has more than 20 years of experience in the field of profile extrusion, with expertise in HPC.



End User



ISV



Technology & HPC Expert

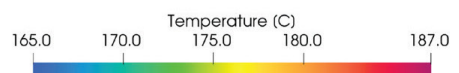
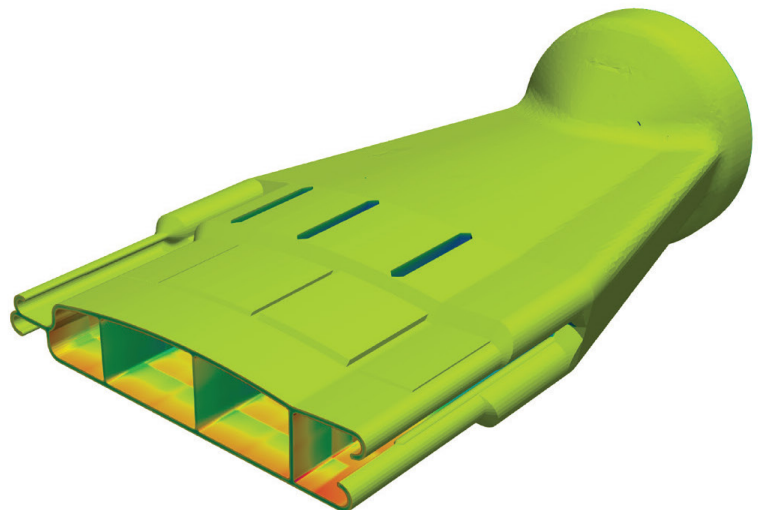
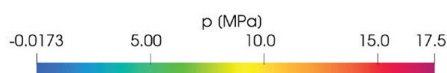
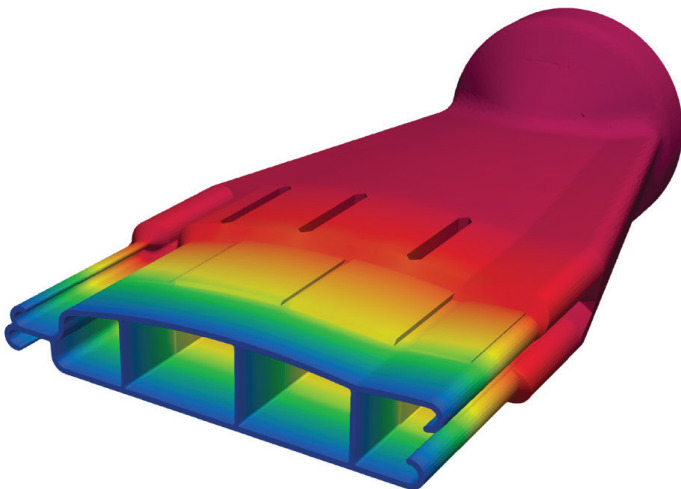


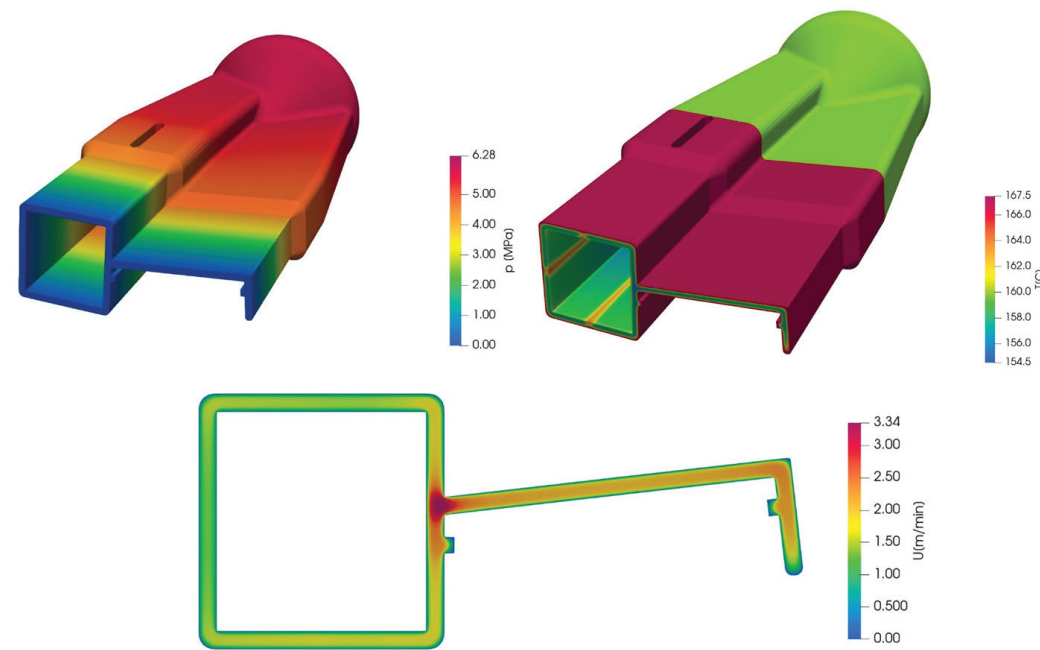
Universidade do Minho

University of Minho is part of the Portuguese NCC.

The Challenge

Plastic profiles are widely used in various sectors due to their competitive properties and design flexibility. However, their trial-and-error-based design approach, dependence on designer experience, and high material and time requirements hinder development, increasing costs for Soprefa. To address this, a simulation framework is needed to enhance the design process, reduce costs, and deliver higher-quality profiles within industry timeframes.





Industry Sector
Manufacturing

Technology used:
CFD Simulation

The Solution

The experiment provided Soprefa with computational tools based on open-source and free-access computational libraries. The main simulation codes that can run on HPC systems were implemented in OpenFOAM and coupled with the optimization software Dakota. This allowed the extrusion die to be automatically optimized, within an appropriate time frame, achieved by conducting hundreds of trials in just one day, which would be impossible without resorting to HPC systems. The implemented simulation framework can be employed with two different CAD package options, Onshape and Fusion 360. Since the latter is incompatible with the current HPC platforms, it was necessary to implement methods to ensure the communication between the computer that runs the CAD software and the HPC system. The implemented computational framework was tested with different case studies, both for improving previously designed extrusion dies, whose desired performance could not be achieved with the traditional experimental based trial-and-error design process, and for newly designed extrusion dies.

The Impact

The results obtained in this experiment clearly emphasize the advantages in terms of product time to market (30-40% reduction) and cost (23% reduction) of using computational modelling running on HPC systems.

Soprefa now has access to a simulation framework that can support its production tools development process, which, based on the results obtained in the experiment, will have a clear positive and immediate impact on their products and facilitate an increase in the number, range and complexity of their products and, consequently, client base.

University of Minho and Wolf Dynamics demonstrated the effectiveness of their know-how for addressing industrial problems. The proposed approach was clearly innovative and allowed them to solve unforeseen issues like the need for having permanent communication between CAD and simulations/optimization tools that run in different environments. The results obtained emphasized the joint skills of the University of Minho and Wolf Dynamics and allowed the latter to start expanding their knowledge in the field of polymer processing. The capabilities acquired in the experiment by both partners are expected to increase their visibility and promote their participation in additional projects where the developed framework can be adapted to applications other than plastic profile extrusion.

Benefits

- A novel improved design methodology for profile extrusion dies, supported by simulation and optimization tools, combined in a framework that can take advantage of the speedup offered by HPC systems.
- Reduction of 30-40% in the product time to market (from 3 to 2 months).
- Minimum Reduction of 40% of raw materials used in experimental trials (from 1 Ton to 600 kg).
- Reduction of the overall cost development by 23% (from €18,000 to €14,000 per tool).
- With a reduced need for trial-and-error, Soprefa is less dependent on contractors for the design of extrusion dies. A more independent die design allows Soprefa to better protect its know-how.