IT Services

Case Study

BlueBEAR provides a substantial computing resource that properly supports the research work of research staff and students at Birmingham. It provides a cost effective facility that optimises the effectiveness of research and ensures the University continues to be a world-class academic learning and research environment.

Modelling the heat treatment of single crystal nickel based superalloys.

Challenges

To build a computer based model to completely simulate the heat treatment process.
To use the model to analyze the response of the material and to optimize the process.

Background

Single crystal Nickel based superalloys are widely used in the aerospace industry to produce turbine blades, which are found in the hottest part of the aero engines because of their excellent properties at elevated temperatures.
The high temperatures reached in the engines are required in order to have a more efficient, and less fuel-consuming engine. But high temperatures require higher properties and therefore materials need to be engineered to show better performances. In metallurgy this is often achieved by means of heat treatment. By applying thermal cycles of heating up, holding and fast quenching, the initially inhomogeneous microstructure is homogenized and better properties are obtained.
So far the heat treatment procedures are mainly based on the experience and little research has been carried towards the understanding and the optimization of the process. The aim of this research is to apply modelling capabilities to study the heat transfer during the heating and the gas flow during the quenching with the final goal of obtaining the best treatment.

Results

The simulations performed using ANSYS Fluent showed realistic predictions of the temperature evolution inside the samples during the heating up stage and of the heat transfer coefficient during the quenching. Furthermore the model helped to assess the importance of various parameters like operating pressure or gas inlet velocity. The results so far are promising but further refinement of the model is needed in order to obtain quantitative validation.

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Product Used
ANSYS Fluent

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