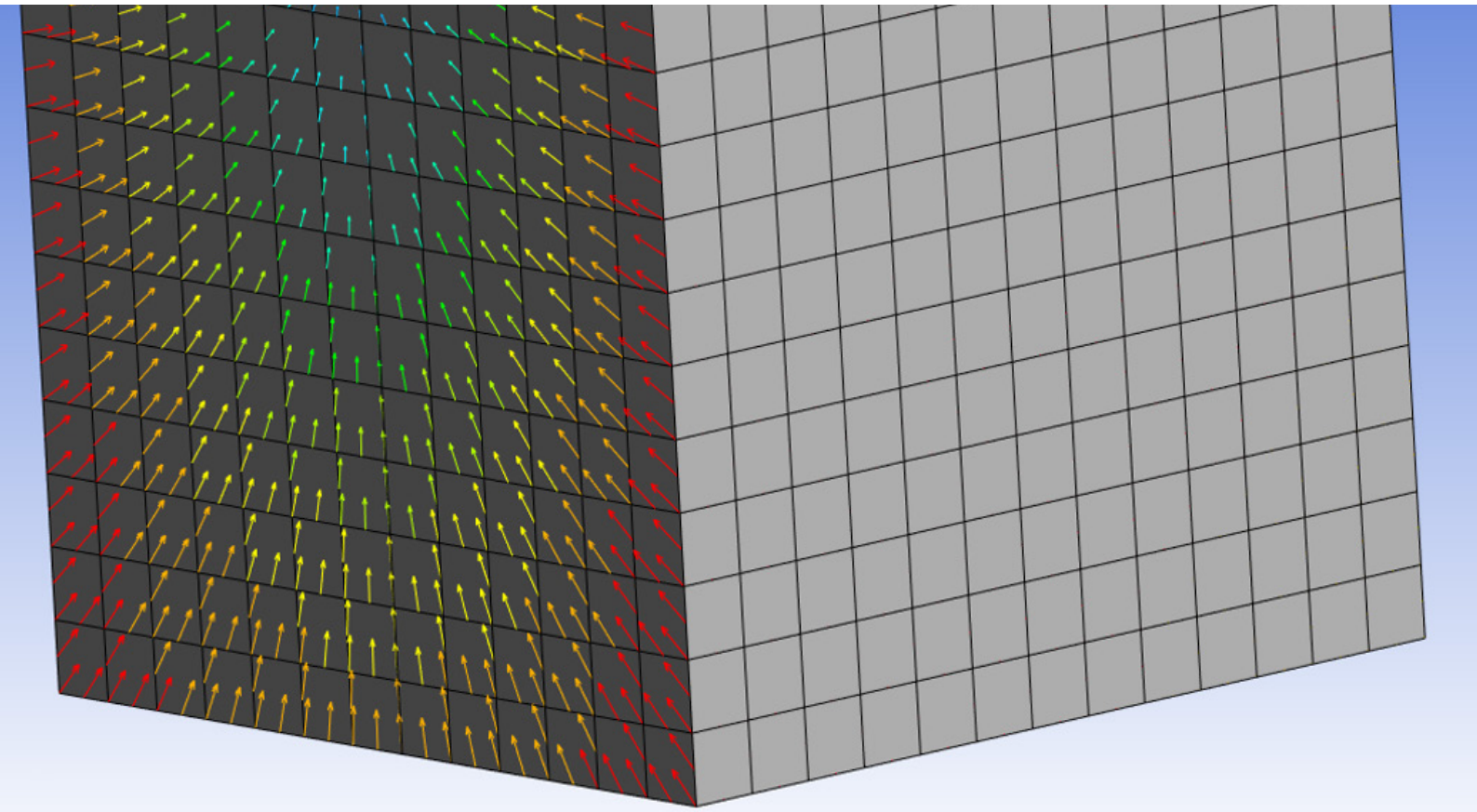
Case study

NUCLEAR AMRC
ADVANCED MANUFACTURING RESEARCH CENTRE



Simulations identify real savings for **heat treatment users**

Digital engineers from the Nuclear AMRC completed a set of complex simulations to help improve the efficiency of heat treatment processes, saving energy, time and money for industrial users such as Abbey Forged Products.

The work was part of a collaborative project called AI6S, which is developing a suite of process optimisation tools based on artificial intelligence and lean six sigma practices to reduce the energy used in heat treatment.

Heat treatment is widely used in industry to improve the material performance and integrity of components produced by casting, forging and other forming processes. Heat treatment processes are energy intensive in their own right, and any errors can lead to the component being scrapped with heavy additional costs in time, money and emissions.

The Nuclear AMRC's work focused on process simulation and verification, to support the development of machine-learning regression models for process optimisation. Training these models requires detailed data on how components behave under heat treatment, as well as information on process parameters, product quality and energy consumption.

To understand the effect of heat treatment parameters on material integrity and performance, the researchers developed detailed simulations of typical products from two of the project partners – a metal forging from Sheffield-based Abbey Forged Products, and a glass bottle from specialist consultancy Glass Technology Services.

The Nuclear AMRC team carried out finite element simulation of the heat treatment process on these digital twins, with the results validated against physical test data from the industrial partners.

"It was great to have support from the Nuclear AMRC, as it's invaluable to have science-backed analysis to enable change decisions." Steve Savage, Abbey Forged Products

The simulations allowed the researchers to collect the data needed to develop the models, without any interruption to the partners' production.

"Collecting real data would have involved interfering with manufacturing, which would cost money and time to the manufacturer," says Arman Zonuzi, technical lead for machining simulations.

Giving manufacturers the ability to improve process efficiency without taking time out for trials is one of the key benefits of the AI6S approach.

"With current lean six sigma methods, efficiency is improved through an iterative approach which involves repeatedly stopping or reducing production for experimentation," Zonuzi explains.

"Our aim is to digitalise this process and help partners achieve right-first-time production. Our simulations and the regression model help us understand where the bottlenecks in the process are, and allow us to optimise process parameters to reduce carbon emissions and save time."

Initial trials of the optimisation tool have demonstrated significant time and money savings, with reduced carbon emissions and increased production efficiency for both industrial partners.

"It was great to have support from the local Nuclear AMRC facility, as it's invaluable to have science-backed analysis to enable change decisions," says Steve Savage, strategic operations manager at Abbey Forged Products.

The two-year AI6S project was led by London-based industrial software developer HyBird, with £1.4 million funding from UKRI through the Transforming Foundation Industries Challenge. Other partners include Derby-based technology specialist Ivy Tech and the Brunel Innovation Centre.

The partners estimate that the tools, if applied across a range of foundation industries, could reduce annual emissions by the equivalent of 21,800 tonnes of carbon dioxide in the UK alone.

www.abbeyforgedproducts.co.uk

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