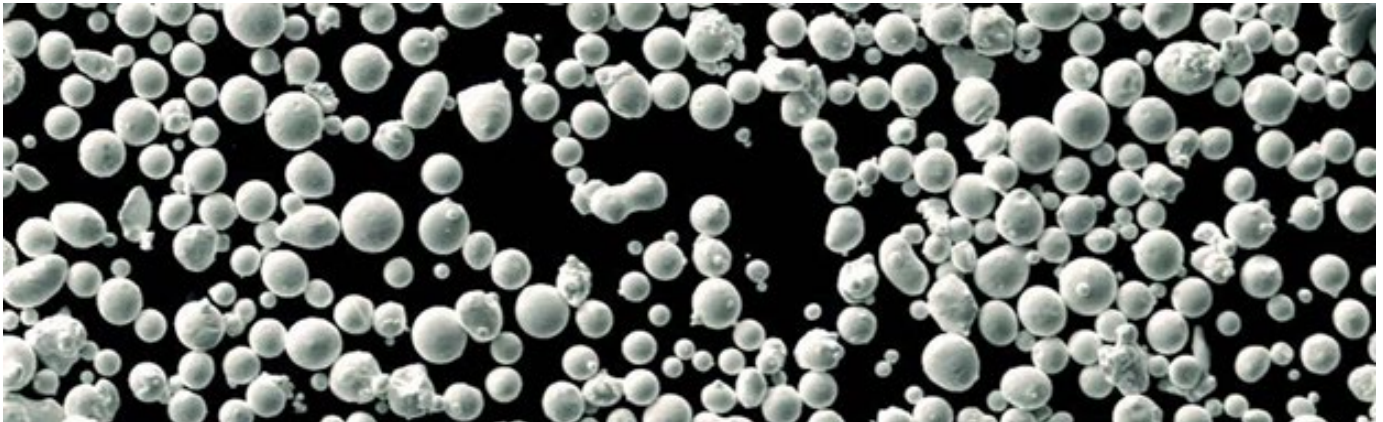


# **ASTUTE 2020 Case Study:**

## **Computational Engineering Modelling and Manufacturing Systems Engineering**



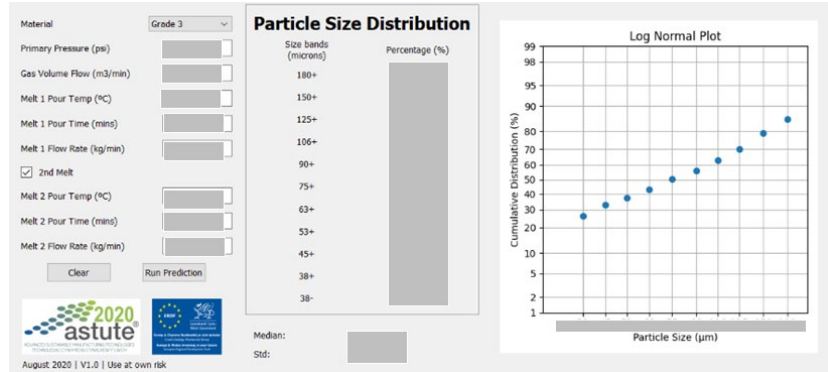
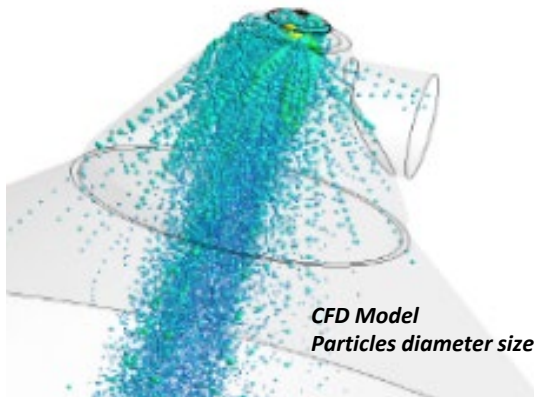
## **Optimisation of Metal Powder Particle Size Distribution from Wall Colmonoy's Gas Atomisation Process**



Wall Colmonoy is a globally leading materials engineering group manufacturing Colmonoy® surfacing and Nicrobraz® brazing products, precision castings, coatings, and engineered components across aerospace, automotive, glass container, oil and gas, mining, energy and other industrial sectors. An important activity is the production of fine metal alloy powders used in surface coating and brazing. Determination and control of the metal powder Particle Size Distribution (PSD) is an engineering challenge due to the complex multi-physics phenomena involved in the atomisation of the molten alloy by high velocity gas jets.

The collaboration with ASTUTE sought to achieve a better understanding of the physics of gas atomisation and the relationship between process conditions and metal powder PSD.

**“This collaborative research ASTUTE2020 project with Wall Colmonoy has been an excellent opportunity to deploy team expertise in advanced computational fluid dynamics and machine learning capabilities. This helped the company in upgrading their gas atomisation facility and reducing waste.”**



**Machine Learning Tool tailored to Wall Colmonoy needs**

**“This project has enabled Wall Colmonoy to further understand the complex multi-physics atomising process and optimise the key process variables. The Machine Learning Tool allows us to predict and optimise the particle size distribution without incurring the cost and time of processing physical batches”**

**Tom Roblin, Project Engineering Manager,  
Wall Colmonoy Limited (UK)**

**3D simulations Velocity Field**

## Computational Fluid Dynamics

Computational fluid dynamics was used to simulate the flow field of gas and molten alloy inside the atomization chamber and the formation of metal particulates. A three-dimensional model captured important flow features such as the near field jet expansion caused by high-speed gas jets, and the flow reversal that causes satellite particle formation. Furthermore, the CFD analysis showed the effect of different exhaust pressures and exhaust port locations.

Primary particle breakdown could not be accounted for using the available computational resources, but the secondary break-down was modelled using the Kelvin–Helmholtz Rayleigh-Transport model. Reasonable agreement with production PSD data was achieved.

## Insights from Machine Learning

Alongside the CFD analysis, ASTUTE also developed the Wall Colmonoy Machine Learning Tool (WCMLT), an artificial-intelligence-based software able to assist our industrial partner in predicting the PSD from the gas atomisation process without running additional experiments.

The predictions rely on a machine learning model based on the PSD data collected in previous batches and extrapolates/interpolates that knowledge for new scenarios.

This approach is a modern alternative to rule-based systems and can be applied to virtually any kind of dataset.

## Impact

The collaborative project between Wall Colmonoy Limited and ASTUTE 2020 has enabled the company to progress in their research and development.

Relationships between the atomisation process conditions and the achieved particle size distribution of alloy powders have been established and clarified.

The CFD simulations allowed Wall Colmonoy to optimise the atomisation tower geometry, improving the stability of the atomising process and the morphology of the powers produced.

The WCMLT machine learning tool achieved a median percentage error of 6% for the particle size distribution prediction. For such a complex process, this accuracy is attractive as it allows the company to better understand and quickly predict the relationship between process conditions and product.