

# Research at EPCC: expanding the boundaries of understanding

We are widely recognised for our world-leading research across a range of areas such as high performance computing, computational science, computing systems, data science, and machine learning. EPCC's research is often located at the intersection of science and computing, and one of our missions is to enable world-class science using computational resources and computational approaches.

## Driven by curiosity

Since its inception, EPCC has had a vibrant research culture. Our position at the interface of different domains and our partnerships with collaborators in many disciplines enable us to locate where research can bring benefits, and implement and provide those benefits for a wide range of communities across research and industry. Some current examples are given here.

### ASiMoV Strategic Prosperity Partnership

ASiMoV Strategic Prosperity Partnership, which EPCC leads with Rolls-Royce, is developing the world's first simulation of a full gas turbine.

By 2030, the goal is to work towards the "virtual certification" of aircraft engines by modelling gas turbines in operation. This requires a unique combination of fundamental engineering and computational science research to address a challenge that is well beyond the capabilities of today's state of the art.

### Quantum computing

EPCC is exploring the application of quantum computing to end user challenges, how quantum computers can be programmed efficiently and effectively in collaboration with traditional high performance computing systems, and where the quantum advantages might be. This includes a range of pathfinding projects for application domains on how and where quantum computing could be used to significantly reduce computational time or costs.

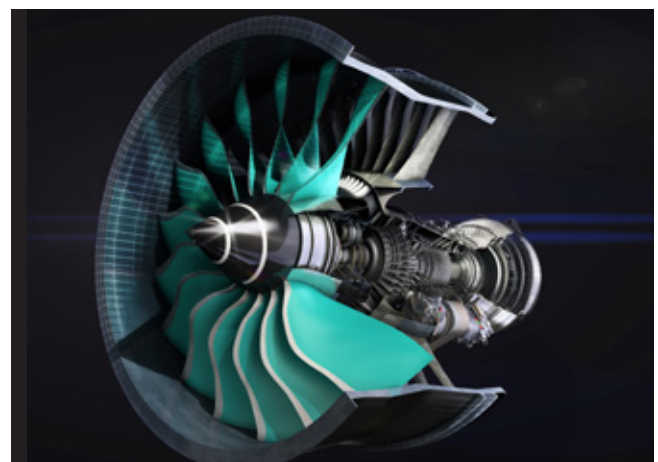


Image courtesy Rolls-Royce.

### Exascale

One key theme of research at EPCC is around exploiting the very largest computing systems for research and discovery. This has included a range of projects within the UK-funded ExCALIBUR programme, a £45.7m initiative to prepare high priority applications for Exascale and progress cross-cutting domains such as algorithm design to maintain a leading position for the UK in high performance computing.

### Net Zero

Exploring how to provide high performance compute with minimal environmental impact is key for our future. We have delivered significant energy savings on our ARCHER2 service as part of this and are looking at how we can increase the efficiency of computing systems and machine hosting to minimise waste and environmental impacts

## Research themes

Our drive for innovation falls into the following themes.

### Application performance optimisation and development

Our long history of operating high performance computing systems has given us deep experience of optimising and fine tuning scientific applications to achieve the best possible performance.

### Parallel programming models

EPCC has been involved in the development of parallel programming approaches, such as MPI, OpenMP, and OpenACC, since their inception.

### Parallel I/O performance

Contention for shared resources in a system can significantly impact application performance. We research techniques to mitigate such performance bottlenecks and exploit novel hardware resources to match application demands in high performance computing. We have recently demonstrated high performance data storage for weather applications using the DAOS object storage system.

### Machine learning

We examine the possibilities and opportunities presented by machine learning in a scientific environment – specifically pattern recognition and



Portra via Getty Images.

interpretation in large data sets, as well as how to integrate machine learning with computational simulation for large scale applications.

### Novel architectures

We investigate and assess the viability of novel hardware and architectures at the leading edge of high performance computing. EPCC has a RISC-V hardware testbed that is available for researchers to access and explore.

### Quantum computing

EPCC's Quantum Applications Group is exploring how quantum computing will impact high performance computing and data science.

### Computational imaging

In collaboration with academics and researchers from medical imaging, radio astronomy and optimisation disciplines, we are working to generate high resolution, high precision, images from medical imaging and radio telescope datasets.

### Research software engineering

As the lead site for the Software Sustainability Institute, EPCC has been instrumental in the development of research software engineering as a profession and, subsequently, as an area of research.

### Hardware testbeds and services

EPCC researches the exploitation of novel hardware to accelerate numerical and data intensive applications. Recent examples include work enabling porting Fortran to FPGAs with simple tools, and exploring RISC-V hardware architectures for HPC applications.

## Contact

See our website for details of our research activities and publications. To discuss research collaborations please contact our Director of Research, Adrian Jackson: [a.jackson@epcc.ed.ac.uk](mailto:a.jackson@epcc.ed.ac.uk)