



# Innovating partnership to make space sustainable

Space debris is a global problem and the process of planning and operating a mission to dispose of the millions of pieces is expensive and time-consuming. To help combat the issue the UK Space Agency has set out funding and partnered with Fujitsu and a consortium, which have combined quantum-inspired computing and AI to help transform space debris removal by determining the minimum fuel and time required to de-orbit inoperable spacecraft or satellites.

## About the customer

UK Space Agency provides technical advice on space strategy and guides the UK space sector to deliver the government's vision. It designs programmes that implement government strategy and is also an early-stage investor in space research and development. The organisation promotes the UK space sector's interests and achievements, making connections to join up industry and academia, while representing the UK in international space programmes.



**“Fujitsu has demonstrated the real-world significance of keeping space uncluttered, assuring its accessibility for future generations.”**

Jacob Geer, Head of Space Surveillance and Tracking, UK Space Agency

## Challenge

Millions of items of space debris travelling at 17,000 miles per hour threaten to destroy or significantly damage active satellites and space assets such as the International Space Station. Tracking and disposing of them is expensive and time-consuming. The consortium wanted to make the process faster and more efficient.

## Solution

Fujitsu Digital Annealer and Quantum-Inspired Optimisation Services, combined with artificial neural networks (ANN), to solve some of the main problems with the commercial viability associated with active debris removal mission planning and design.

## Outcomes

- 25% faster mission time, more efficient collection of space debris
- Fuel consumption has reduced by 18%
- Reduced costs due to lower fuel weight at launch
- Digital Annealer calculates mission scenarios 10,000+ times faster

**£100k+**

saved per mission launch through reduced fuel requirements

## Eliminating hazardous space debris

Space debris is a risk for companies operating in space. It is estimated that there are over 2,500 non-operational satellites, as well as more than 130 million pieces of debris bigger than the size of a coin, travelling at over 17,000 miles per hour. That's big and fast enough to destroy an orbiting satellite, creating in turn even more space wreckage.

That means missions into space must be carefully planned. New companies are also looking at how we can remove some of this debris from space quickly and cost-effectively. Finding the optimal route to collect debris will save time, energy and improve the commercial viability of such ventures.

“It's like driving down the motorway if the wreckage from every crash that had ever happened was still there,” explains Emily Mills, Domestic Space Tracking Lead at UK Space Agency. “Each piece of debris has its own trajectory, with an infinite number of options to capture it.”

## Combining neural networks with quantum-inspired computing

The UK Space Agency set out on a programme committing funding to combat the space debris issue. It has partnered with Fujitsu, Astroscale UK, University of Glasgow and Amazon Web Services (AWS) to successfully combine quantum-inspired computing and AI to transform space debris removal. The project, developed over six months, leverages both artificial neural network (ANN)-based rapid trajectory design algorithms, alongside the Fujitsu Digital Annealer and Quantum-Inspired Optimisation Services. It solves some of the main problems associated with active debris removal mission planning.

First, space debris data is input to the platform, and passed to the neural network hosted on AWS, which calculates the optimum orbital transfer costs in terms of fuel and time. The data is then passed to Fujitsu's Digital Annealer to find the optimal transfer based on a variety of priorities – such as mission length, risk or mission costs. The optimal manoeuvre selection is then passed back to Astroscale UK.

“Monitoring hazardous space objects is vital for the protection of services we rely on – from communication devices to satellite navigation,” adds Jacob Geer, Head of Space Surveillance and Tracking at UK Space Agency. “This project is one of the first examples of quantum-inspired computing working with AI to solve the problems caused by space debris.”

## Faster, more efficient, less expensive

By carefully deciding the best combination of space debris items to collect and in which sequence, the quantum-inspired solution, powered by the Fujitsu Digital Annealer, optimises the mission plan to determine the minimum fuel and minimum time required to bring inoperable spacecrafts or satellites safely back to the disposal orbit. Missions can be planned more efficiently so organisations can pick up more debris, 25% faster than ever before. As a result, fuel consumption has reduced by 18% and costs are less due to lower fuel weight required at launch. The shorter mission time also leads to lower operational costs, enabling more missions to be controlled per year, thus increasing the revenue rate.

“The UK is committed to ensuring the sustainability of space,” concludes Geer. “Fujitsu, working with Astroscale UK, the University of Glasgow and AWS, has demonstrated the real-world significance of keeping space uncluttered, assuring its accessibility for future generations.”

## FUJITSU

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