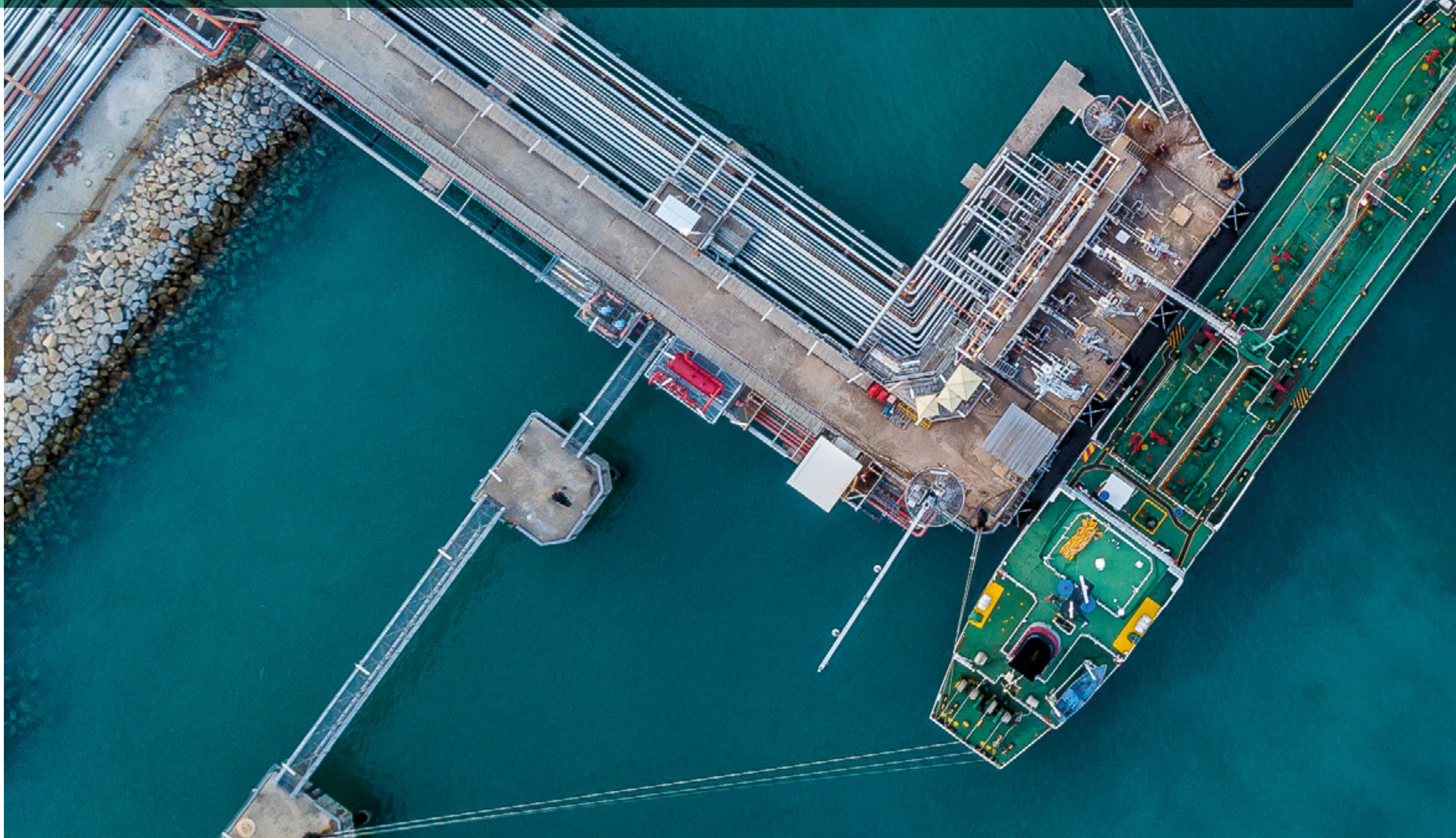
REDUCING SHIPS' FUEL EMISSIONS USING AI SOFTWARE

Engineers from the University of Southampton have partnered with met-ocean forecast data specialists Theyr Ltd to create an efficient voyage optimisation solution for commercial vessels.



"Working with the University as a leading centre for maritime technology will provide a springboard for our commercial product and acceptance within this market."

David Young
Managing Director, Theyr

For further information, visit:
www.southampton.ac.uk/engineering/research/groups/maritime-engineering.page

3%
Shipping accounts for about 3% of the world's greenhouse gas emissions

Increasing the robustness and effectiveness of voyage planning is at the heart of a Southampton collaboration with Theyr Ltd. Dr Adam Sobey and Dr Przemyslaw Grudniewski, from the Maritime Engineering group at the University, are working with the weather forecasting provider to combine real-time met-ocean satellite data with a world-leading 'genetic algorithm' that will allow vessels to avoid poor weather and travel at efficient speeds. This will reduce greenhouse gas emissions.

Shipping is a particularly efficient form of transport but it still accounts for about three per cent of the world's greenhouse gas emissions. With more than 50,000 commercial vessels operating in our oceans there is plenty of room to improve the efficiency of these vessels to help our planet. This view is supported by shipping's regulators and there is increasing legislative pressure to reduce emissions. This increase in legislation, combined with the increase in the cost of compliant fuels, has led to a high demand for solutions to reduce the fuel consumption of commercial vessels.

The year-long SPRINT-funded project is a perfect illustration of merging commercial data and technologies with innovative university research as it is planned to use the Iridis 5 supercomputer, the UK's largest academic supercomputer located at the University of Southampton, to accelerate the verification process.

"This SPRINT project enables the acceleration in development of a benchmarked routing solution," said David Young, Managing Director of Theyr Ltd. "Working with the University as a leading centre for maritime technology will provide a springboard for our commercial product and acceptance within this market. The University brings 10 years of relevant research and development to the project and we couldn't ask for a better accelerator. Without SPRINT, a solution would take some additional years to complete."

The project aims to exploit how two recently developed genetic algorithms can be used to take advantage of the increasingly higher fidelity data that is being made available. "Genetic algorithms are population-based search algorithms based on Darwin's theory of evolution," said Adam, who is also co-lead of the Marine and Maritime group in the Data-Centric Engineering programme at The Alan Turing Institute. "They were first introduced by Alan Turing, with a number of improvements having been proposed over the past decades.

"It is one of the key algorithms in the AI toolbox as it can accurately approximate large-scale problems, maintaining the balance between exploration of the possible solutions and convergence towards the best solution in its search. These tools have been utilised in a range of applications including the design of spacecraft antennas for NASA and in computer games."

Southampton researchers have developed new methods that replicate multi-level selection, the theory of natural selection that proposes that the fitness of an individual can be judged not only on their own fitness but also the collective of individuals with which they are associated (for example, a wolf and the pack it belongs to). This has led to an algorithm that exhibits a high diversity and is particularly strong on large or constrained problems.

The research will develop a path-routing algorithm, or set of algorithms, that can be used on different problems, from short paths with higher fidelity met-ocean data, to longer paths with lower fidelity data. This will future-proof the software against these increases in fidelity and provide leading performance over competitor software, reducing the emissions at sea through more effective utilisation of high-fidelity data.

Adam continued: "We hope a number of student projects will be developed in parallel to this research to help the team solve these challenging issues and provide creative solutions to deliver real world impact."

LAUNCHING LESSONS FROM COVID-19 INTO SPACE

Cleaner air, reconnecting with nature, less rushing, and a fresh appreciation of the simple things in life. Although the negatives outweigh them, there are some unexpected positives that have emerged from the COVID-19 crisis.

But one positive that Southampton researchers didn't see coming was how two sets of very different work within the Active Living for Health Research Group could suddenly become mutually beneficial. One piece of work concerns astronauts' muscle health and the other concerns setting up virtual physiotherapy clinics.

Monitoring astronauts' muscles

A team of European researchers is about two years into a project testing pioneering methods to monitor astronauts' muscle health.

The Myotones Project, funded by the European Space Agency (ESA), is monitoring muscles of astronauts in space in preparation for further research to tailor exercise to combat the currently unavoidable loss of muscle function experienced through being in space.

Input to the project from team members in Health Sciences at the University of Southampton – Professor Maria Stokes, Dr Martin Warner and Paul Muckelt – is funded by the UK Space Agency and the Science and Technology Facilities Council.

Maria said: "The astronaut Tim Peake was an excellent example of why this research is needed – he was very fit and determined to stay so. He ran a marathon up in space, yet had difficulty walking when he got back to Earth. We need to develop methods to prepare astronauts more effectively for landing on a planet, whether that's returning to Earth or landing on Mars."

The team, led by Professor Dieter Blottner from the Charité University Medicine Berlin in Germany, is using the unique combination of both a novel handheld device, called the MyotonPRO, which measures tone and stiffness of muscles, and ultrasound imaging to measure soft tissue thickness.

Southampton's expertise comes in both MyotonPRO experience and ultrasound knowledge. "We were invited to be partners on the project because we've done a lot of research to develop the robustness of the MyotonPRO, looking at its reliability and validity," explained Martin, who brings technical expertise to the project. "So we bring the MyotonPRO knowledge but also a long history of ultrasound imaging expertise."

The combination of these two methods allows the ability to test muscles during a space mission which, until now, was limited due to a lack of suitable equipment. Testing during a mission means exercises can in future be tailored to individual astronauts.

"Currently, astronauts follow an exercise programme in space for about two hours a day but adjusting their exercise plans to target the most in-need muscles while in space is challenging, as it varies from person to person," said Maria. "Providing the physio and doctors with data on how an astronaut's muscles are changing will help them tailor that individual's training inflight. We test their muscles before they go into space, we monitor them when they are in space via a direct link, then we run tests when they return to Earth for up to three months after landing."

Before their mission, the astronauts are trained at the European Astronauts Center (EAC) in Cologne, Germany. They are taught how to use the equipment so they can test each other in space. Data collection pre- and post-flight is performed at the EAC and at the NASA Johnson Space Center in Houston, USA, with the support of ESA and NASA missions coordinators and specialists.

To monitor the astronauts inflight, a member of the team travels to the CADMOS space station in Toulouse, France, where there is a direct link to the International Space Station.

This live interaction with the astronauts poses a very practical challenge: how to deliver instructions and assist with astronauts' testing via a video link.

Research Fellow Paul Muckelt said: "Guiding an astronaut to get a good image is very