DELL Technologies intel

Innovating with data — to fight a global pandemic

Drawing on the power of high performance computing, Welsh researchers create a platform for modeling the spread of the deadly SARS-CoV-2 virus.

Swansea University Prifysgol Abertawe

Scientific Research | Wales

Business needs

Researchers at Swansea University need leading-edge high performance computing solutions for computationally intensive science, including research into the spread of deadly diseases.

Solutions at a glance

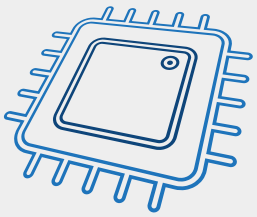
- Dell EMC PowerEdge servers with Intel® Xeon® processors
- Dell EMC PowerSwitch S3048-ON
- Dell EMC PowerVault MD3420 storage

Business results

- Accelerating life-saving scientific discoveries
- Providing insights into limiting the spread of the COVID-19 disease
- Helping government decision makers establish data-driven policies
- Establishing a platform for scientific collaboration

The HPC facilities at Supercomputing Wales comprise two hubs with a total of

13,080 cores



The HPC supercomputing hubs connect to more than

2 PB of storage

Research with real-world benefits

Swansea University is a research-driven university that has been making a profound impact on people's lives since 1920. The University community thrives on exploration and discovery, and strives to offer an ideal balance of excellent teaching and research, matched by an outstanding quality of life.

As part of its mission, Swansea University is committed to conducting research with real-world benefits — research that changes the world and saves lives. To that end, the University encourages interdisciplinary research that spans many academic areas, an approach that encourages original thinking and collaborative projects to create innovative outcomes.

This is the approach that Swansea University is taking in its research efforts that focus on the fight against COVID-19. In one of these projects, Swansea University academics — Research Software Engineers Ed Bennett and Ben Thorpe, Epidemiologist Professor Mike Gravenor and Mathematics Professor Biagio Lucini — are part of a major research initiative that is investigating the mechanisms that influence the transmission of the SARS-CoV-2 virus and the deadly disease that it causes.

This is about much more than theoretical science. This is about using scientific modeling and simulation to give healthcare authorities the guidance they need to prevent surges of pandemic patients from overwhelming hospitals — so all people can get the care they need. This is about using the power of math and supercomputing to change the world.

An open platform for pandemic modeling

Mathematical modeling of infectious disease transmission is an important tool in forecasting future trends of pandemics. However, different models tend to give different results. And that's why it's important to look at problems from many directions, according to Lucini, leader of the university's research software engineering team.

"To draw robust conclusions from modeling, it is important to consider multiple models, which can be facilitated by expanding the modeling community, as model predictions reflect the assumptions on which they are developed, and by bringing models and developers together to compare and contrast their findings," Professor Lucini says.

To that end, the Swansea project aims to not only empower the next generation of modelers, but also to act as an incubator for an open platform for comparisons of different infectious disease models. This platform is helping researchers determine demographic, socioeconomic and clinical risk factors for infection, morbidity and the mortality of COVID-19 — and save lives along the way. It can also enable researchers to measure the impact of COVID-19 on the use of healthcare resources and the effect on long-term health, while supporting the evaluation of natural experiments of policy interventions.

"We launched this project at the request of the Welsh government, and in collaboration with local epidemiologists," Prof. Lucini says. "The purpose of this project is to create scenarios for the ways in which infections of COVID-19 evolve in Wales, so that the government can better understand how to react to such potential surges. In particular, we work with the technical advisory cell of the Welsh government, which is the consultation body for these types of decisions."

In these efforts, the Swansea research team is modeling how the COVID-19 infection spreads, the effects of non-pharmaceutical interventions and of social restrictions, such as closing pubs, restaurants and schools. This multi-faceted approach recognizes that infections stem both from the nature of the SARS-CoV-2 virus and our social interactions, which greatly influence the spread of the disease.

"Essentially the virus has an ability to infect that depends on the nature of the virus itself, but also on our social interactions," Prof. Lucini says. "For example, if I'm infected and I live on the moon, I don't have any ability to infect anyone. But if I am infected and I go to the disco and dance with 100 people around me, chances are that I will infect all of them."

To determine the potential spread of infections, Prof. Lucini and his colleagues throw a lot of high-powered math at the problem. More specifically, they develop algorithms, or mathematical models, that describe how the virus infects people and those they come in contact with.

'This is really a case in which lives have been saved, thanks to the application of the model.'

— Prof. Biagio Lucini, Swansea University

‘We often think of mathematics as something that is very abstract and supercomputing as something that is for specialists. What I like people to remember is that mathematics and supercomputing can, and do, save lives.’

— Prof. Biagio Lucini, Swansea University

In this work, the research team members are essentially innovating with data by creating various “what-if” scenarios based on different assumptions.

“For instance, when we observe that infections are rising, we will study what will happen if we close the schools, and what will happen if we close the restaurants,” Prof. Lucini explains. “And we pass those data to decision makers, and discuss our results with them. They will then analyze our data contextually with other data on the economy or mental health and other variables, and then they will decide what to do in terms of policy.”

This is very much applied science. Prof. Lucini notes that decision makers in the Welsh government cite the Swansea model’s prediction to help guide their decisions and the policies.

“The model works,” he says. “And by that I mean, beyond personal satisfaction or academic pursuits, this is really a case in which lives have been saved, thanks to the application of the model.”

Supercomputing Wales

For their computationally-intensive scientific investigations, the COVID-19 researchers at Swansea University tap into the high performance computing resources of Supercomputing Wales, the national supercomputing research facility for Wales.

Supercomputing Wales provides researchers across the nation with access to powerful computing facilities for science and innovation projects. The program’s facilities are used by research groups at Cardiff, Swansea, Bangor and Aberystwyth universities, along with private companies and other partners working on collaborative projects.

These resources from Supercomputing Wales include supercomputer hubs based at Swansea and Cardiff universities. These systems — built by Dell Technologies and Atos — contain more than 13,000 cores, tens of terabytes of memory and hundreds of terabytes of high performance storage, all interconnected by low-latency/high-bandwidth networking.

At the heart of the Supercomputing Wales initiative is a Supercomputing Centre of Excellence spearheaded by Atos and Dell Technologies. This joint center provides Welsh researchers with a full suite of leading-edge HPC equipment, software and services. Along with the two supercomputer hubs, the center provides two Atos BullSequana S Datalake appliances.

With its high-powered HPC resources, Supercomputing Wales is facilitating a step change in supercomputing activity across strategically important sectors of the Welsh economy — including life sciences and health; nano-scale materials and advanced engineering; and energy and the environment. A commonality to these diverse domains is a shared need for leading-edge HPC facilities to drive computational science — and potentially life-changing discoveries.

“If I can synthesize everything in a sentence or two, I would say we often think of mathematics as something that is very abstract and supercomputing as something that is for specialists, which may or may not be true,” Prof. Lucini says. “What I like people to remember is that mathematics and supercomputing can and do save lives.”

The full story

For a deeper dive into the COVID-19 research conducted by Prof. Lucini and his colleagues, see the research paper “Understanding and responding to COVID-19 in Wales: protocol for a privacy-protecting data platform for enhanced epidemiology and evaluation of interventions.”

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