

A Week to Tackle Knotty Industry Problems

The 187th European Study Group with Industry (ESGI) saw about 100 researchers descend on the University of Bristol in July. The participants and problems addressed spanned the whole of the mathematical sciences – including physical applied mathematics, pure mathematics, statistics, operations research, data science and machine learning/AI – reflecting the rich diversity of expertise that ESGI brings together.

This was the fourth time the University of Bristol has hosted ESGI since 1992 (see box). The participants included many PhD students and academic researchers from across the UK, Europe and as far as Canada. The largest delegation were a group of mathematicians from Kazakhstan, who are looking to organise their own ESGI.

A special tribute was held for Kamil Kulesza from the Polish Academy of Sciences who sadly passed away last year. He was instrumental in promulgating the tradition of study groups in his own country as well as in the developing world.



In the tradition of ESGI, there are only two fixed points in the week; on the Monday morning different companies pitch problems that require a mathematical treatment, then on Friday, the ‘solutions’ are presented. In between, each problem is assigned a room and mathematical and data scientists from across the UK, Europe and beyond work together to bring fresh insight.

The problems worked on spanned industrial engineering and environmental data analysis to AI-driven image analysis and optimisation challenges. They came from large companies such as VodafoneThree and the national air traffic control service (NATS), and from small and medium-sized enterprises (SMEs) such as Bristol-based internet safety specialists CameraForensics and a team from Paebbl in the Netherlands who are aiming to produce novel carbon negative concrete at scale.

Another problem was from engineers at SS Great Britain who want to reduce the carbon footprint of a system used to stop further corrosion by blowing hot air at the underside of the ship.

A timely problem was brought by Stream, a collaboration between most of the UK’s water companies. They want a mathematical model to optimally enable citizen scientists to collect the crucial data that can identify specific sources of pollutants.

At the Friday presentation, problem proposer after proposer was amazed at the unique insights of each group. The most fulsome praise came from the two smallest SMEs, both focussed on digital innovation within the construction sector. Mapscape wanted a mathematical model for tree growth that depends both on tree location and life cycle of the individual tree species.

A brief history of ESGI

The tradition of the ESGI stretches back to the Oxford Mathematical Study Group with Industry in the late 1960s. It was wonderful to see John and Hilary Ockendon attend one day of the meeting as they were part of the team that set up the first study groups.

The groups expanded to the European Study Groups with Industry in the 1990s. There are now five to seven events annually, hosted by universities across Europe, and the format has been copied across the world.

Surveyr are developing AI tools to help surveyors identify the severity of property damage using image analysis. Amy Stone of Surveyr said:

I could not believe how far the mathematicians got. I thought I knew all about AI and data science, but the new thinking and approaches that they brought to the problem was beyond my wildest dreams.

David Winlo of Mapscape was similarly impressed:

The results are incredible, my colleague Darren Johnson and I are very impressed with the mathematical model produced, which provides an industrially implementable solution for predicting tree canopy growth over time.

After the ESGI, participants write up their results into reports that are made available on a public repository (see tinyurl.com/MIIR-reports). Funding is available from the UK Knowledge Exchange (KE) Hub for teams to follow up with each of the companies. To that end, Daniel Herring spoke about his innovative work with Hy-Met who presented a problem on monitoring battery performance at last year’s ESGI in Birmingham.

Perhaps the greatest benefit of ESGI is the opportunity it gives for participants to flex their mathematical and data science muscles in solving real world problems away from their day jobs. Spanish postgraduate student Nuria Richer Gusano wrote of her experience on LinkedIn:

I had the chance to work on a fascinating real-world problem proposed by the British company Mapscape Limited. It was a great challenge, combining mathematical modelling with environmental data and future planning. What made it even more valuable was meeting such a talented and passionate group of people from across UK universities and institutions. I’m leaving this ESGI with lots of motivation to keep working at the intersection of maths and industry.

The meeting was co-organised by Zahraa S. Abdallah, Matthew Hennessy and Stuart Thomson with support from Alan Champneys, Tom Steuart-Feilding, Jan Farmery, Helen Mawdsley, Lauren Hyndman and Joanna Jordan. The meeting was sponsored by the companies bringing the problems, and with generous support from the IMA, HIMR, ICMS, ECMI, EPSRC, UK KE Hub and the University of Bristol enabling all participants to engage in the meeting for free.

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