

Warwick Centre for Complexity Science

Newsletter Issue 5, Winter 2016

MIR@W day

by Colm Connaughton, Director Centre for Complexity Science

Building on the success of last year's MSc Research Study Groups, we welcomed four more external partners of the Mathematics for Real-World Systems Centre for Doctoral Training to Warwick on February 15th to present this year's study group topics. This year's challenges were brought by the International Agency for Research on Cancer (IARC), Public Health England (PHE), Thales UK, and BT.

The day started with lunch with representatives from the external partners. Each partner then gave a forty-minute presentation about their proposed projects. They detailed the context, aims, and potential pitfalls. Their challenges spanned the full range of our remit: using mathematics to cure cancer (IARC), modelling infections with dose-dependent responses (PHE), intelligent mobility applications for the UK strategic road network (Thales UK) and convex optimisation in communications systems (BT). After the presentations and a tea break, the students took part in break-out sessions with the representatives to discuss their projects in more detail asking questions and proposing new ideas. Great enthusiasm was shown by both students and staff during these sessions as potential research avenues were discussed.

Our MSc students are very excited by the opportunity to work on these projects. We spoke to some of them

about their impressions of the project presentations. **Robert Gowers**, a current MSc student and an MEng graduate who specialised in electrical engineering: "I thought that the problem proposed by Keith Briggs from BT was a very interesting one. The problem is generalisable to applications beyond communication systems. I hope that by the end of the project I will have improved my programming skills and learned a lot about optimisation. I also look forward to contributing to the software library as part of the project." **Luke Whincop**, an MSc student interested in cancer research: "I chose this project because I want to develop a strong background knowledge in the mathematics of cancer. I'm looking forward to finding out more about the new, unexplored areas of cancer research, and whether they can be useful for my PhD project and beyond. My ultimate hope is to help build a strong collaboration between the IARC and Warwick." **Laura Guzman Rincon**, an MSc student who has background in Mathematics and Physics: "I am very excited about the Thales project as it combines both theory and application. It will give me the opportunity to apply the concepts that I have learned during this year. I hope that by the end of it, we can come up with a simple but elegant solution that Thales can implement within a year."

Once Upon a Part-Time in Warwick

by Ellen Webborn, 4th year part-time PhD student

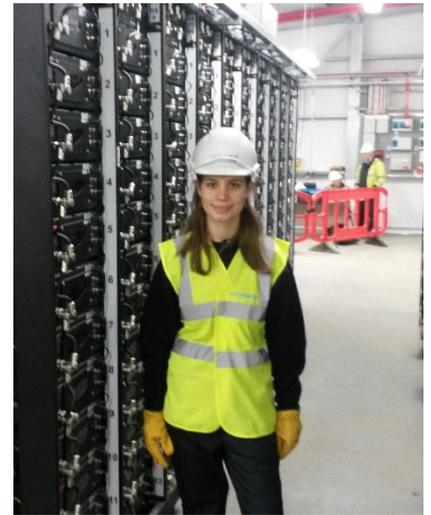
“What’s it like working part-time at National Grid?” is a question I’ve been asked a fair few times by other PhD students. Or as one person put it “how does it feel being an ‘adult’ for some of the week?” It’s true that the two halves of my week seem pretty different, and that it’s up to me to make it work.

For the first half of the week I’m out of the house by 7:40, smartly dressed to be a Power System Engineer for the day at National Grid’s head office in Warwick. At least, that’s what it says on my business cards; in my head I’m still a mathematician learning about the energy industry and applying my skills to problems in engineering. The office is a hot-desking open-plan affair, with lockers, vending machines and brightly coloured corporate messaging. There’s a canteen for lunch which is usually pretty good; perhaps being part-time means the novelty is yet to wear off. My work feeds into structured collaborative projects with deadlines, objectives and things like ‘stakeholder engagement’.

One of the biggest surprises was the sheer quantity of acronyms which even two years on can occasionally catch me out. From big pieces of equipment in the

power grid to regulatory jargon and even safety discussions, almost everything has its own acronym. No amount of mathematical training will prepare you for the steep learning curve required to understand what people are talking about half the time. But you do learn, and ‘adapt to being an ‘adult’’, and pretty soon you’ve converted to acronym central, accepted (with difficulty) the pains of getting anything new installed on your laptop, and even, in my case, joined the company choir (Tuesday lunchtimes, great fun).

After two or three days of ‘real world experience’ I return to my other real world of seminars, chalk boards, free lunches and (in my office) Thursday smoothie club. It can feel like a struggle to get my mind back to where I left things on the previous Friday afternoon or over the weekend, particularly when the work is very theoretical. Total immersion in thesis work would probably allow me to be much more productive in some ways, and this is something I’ll do in the final stage of my PhD. However the insights I’ve gained from learning about how things work in reality and where the big challenges lie going forward has been extremely valuable.



For example, the research I’m doing now in my PhD was motivated by something I’d learned at work, and I’m able to appreciate where my theoretical studies fit into the wider industrial context.

Finding areas of study that are simultaneously academically stimulating, mathematically tractable and industrially relevant has been one of the biggest challenges to bridging between my work and my research. I’m always on the lookout at work for PhD inspiration in the problems industry finds most valuable, and in my research I hope to reach a point when our conceptual mathematical modelling is sufficiently developed to be able to explain it to the engineers I work with, and for them to understand how it can be useful.

New Reading Group

Warwick Agents and Games in Economics Research (WAGER) is a new interdisciplinary research group in the Complexity Science Centre, set up by Gian Lorenzo Spisso, a 1st year PhD student. Attendees are economists, mathematicians and physicists and, more generally, researchers interested in models of interacting economic agents. Shared interests among the group revolve around Economics and Finance and comprise: (Evolutionary) Game Theory, Interacting Particle Systems, Networks, Opinion Dynamics and Agent Based modelling, with some bias toward the more theoretical and mathematical aspects.

More details can be found on the webpage of the group:

<http://www2.warwick.ac.uk/fac/sci/mathsys/people/students/2014intake/spisso/wager/>

Vitalii++

by Peter De Ford, MSc student

This is a short story about the life of Vitalii Iarko, the great Ukrainian programming athlete we have in the Complexity Department. **First steps.** Vitalii began programming in Pascal at the age of 14. His first program generated empty files without any purpose! Then, at the age of 15 he participated in a high-school programming Olympiad and won the first prize. This led to a regional Ukrainian competition, where he got a zero score not because he was bad at programming, but because he didn't know it was a computer that checked the code under specific rules he didn't follow. However, next year he finished in 2nd place!!



Road to success. Vitalii then enrolled in the Informational Security centre at Kharkiv National University. In his first year he joined the RGB programming team. The great success of his team in South East Europe regional contests led Vitalii to be recruited by twin brothers to create the Sobolev team.



Yekaterinburg 2014. In 2014, the Sobolev team entered the ACM ICPC 2014 competition with 10 000 other teams, and qualified for the world finals held at the Ural Federal University in Yekaterinburg, Russia. Once in Russia, the team was equipped with 1 computer, and had to solve 12 problems in 5 hours. Using C++, they solved problems from a variety of subjects: from programming Dijkstra's algorithm for finding the shortest path between nodes in a graph to creating optimal train schedules, and even dealing with N-dimensional surfaces.

NWERC 2015. Vitalii is now enrolled in the Erasmus Mundus Masters in Complex Systems Science at Warwick. Last year he represented Warwick with the "Exception: teamName not found" team at the ACM ICPC NWERC 2015 in Sweden, where they finished 11th.

Future. Even though Vitalii is very young, he has now retired from programming competitions because of age restrictions. Right now he keeps improving his programming skills and considers doing a PhD. Last year he did a three-month internship at the Google Zurich offices, where he hopes to work. We are happy to have Vitalii in the department, and we wish him the best of luck in his career!

Recent publications from our staff and students:

- **Khoromskaia D, Alexander GP.** Motility of active fluid drops on surfaces, *Physical Review E* 92, 062311 (2015)
- **Chau Y, Connaughton C, Grosskinsky S.** Explosive condensation in symmetric mass transport models, *Journal of Statistical Mechanics: Theory and Experiment* 11, 11031 (2015)
- **Maitland M, Grosskinsky S, Harris RJ.** Large deviation analysis of a simple information engine, *Physical Review E* 92, 052136 (2015)
- **Arasardnam RP, McFarlane M, Daulton E, Skinner J, O'Connell N, Wurie S, Chambers S, Nwokolo C, Bardhan K, Savage R, Covington J.** Non-invasive exhaled volatile organic biomarker analysis to detect inflammatory bowel disease, *Digestive and Liver Disease* 48, 148-153 (2016)
- **Irvine MA, Bull JC, Keeling MJ.** Aggregation dynamics explain vegetation patch-size distributions, *Theoretical Population Biology* 108, 70-76 (2016)

Winter Graduation 2016

Congratulations to our first MathSys cohort who graduated from their Masters programme on the 20th of January! Daniel Sprague and Davide Michieletto were awarded their PhDs and the 2013-2015 Erasmus Mundus Masters in Complex Systems Science students were awarded their degrees from both Warwick and our partner institutions: Ecole Polytechnique in Paris, and Gothenburg and Chalmers Universities in Gothenburg. In addition to the official University proceeding, there was also a congratulatory lunch celebration in the Centre where family and friends joined the students in celebrating their success.



Media presence

Congratulations to Federico Botta and Ed Hill! Fede's research on quantifying crowd sizes at football stadiums and airports using mobile phone and Twitter data has been featured on BBC World News, Science Magazine and Business Insider. Ed's analysis on spreading healthy mood in adolescent social network has appeared on The Conversation website. Congratulations to them from the Centre!

Change in the Editorial Team

Federico Botta and Neil Jenkins, both members of the editorial team for all previous editions, are retiring from the team. We thank Fede and Neil for their great work and wish them all the best in their PhD!

We welcome Iliana Peneva, a 1st year PhD student, and Ayman Boustati, Luke Whincop and Peter De Ford, MSc students, on to the editorial team!

Events coming

soon:

Some upcoming Warwick events that may be of interest:

- 16th March 2016, MathSys Open Day
- 29th March – 2nd April, Warwick Mathematics Institute, Probabilistic models from discrete to continuous
- 4th – 8th April, Centre for Research in Statistical Methodology: CRiSM Master Class: Non-parametric Bayes
- 6th – 8th April, Warwick Mathematics Institute, NTD Modelling Consortium Technical Meeting
- 8th April, Warwick Mathematics Institute: Real world risks and extremes: correlation and quantification
- 18th – 22nd April, Warwick Mathematics Institute, Fluctuation-driven phenomena in biological systems
- 20th – 22nd April, Centre for Research in Statistical Methodology, CRiSM Workshop on estimating constants
- 18th – 20th May, Warwick Mathematics Institute, The dynamics of complex systems

Editors:

Gareth Alexander,
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Ayman Boustati,
Peter De Ford,
Neil Jenkins,
Iliana Peneva,
Luke Whincop