A graph that evolves over time

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Time is an important component in many real-world network problems. In this talk, we introduce a time-dependent network model, called an evolving graph, and discuss why they are useful. We illustrate how to search an evolving graph, comparing with the static graph case. Finally, we construct an evolving graph from a database of scientific journals and show how an evolving graph model can be useful for academic search.

Formation & Coalescence of Liquid Drops

James Sprittles

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Understanding the formation of liquid drops and their coalescence with surrounding drops is the key to optimising a whole host of technological processes, including a number of emerging microfluidic devices such as 3D-printers and lab-on-a-chip devices. Accurate experimental observation of these phenomena is complex due to the small spatio-temporal scales or interest and, consequently, mathematical modelling and computational simulation become key tools with which to probe such flows.

Drop formation and coalescence will be shown to be from a class of so-called 'singular' capillary flows, in which classical modelling approaches lead to infinite values of flow variables and standard CFD fails. Simulations will reveal (a) the dominant physical mechanisms in these flows, (b) the accuracy of similarity solutions proposed for them and (c) a number of previous mis-conceptions in the published literature. Finally, I will discuss how the new findings open up a number of challenges for both theoretical and experimental analysis.

Equations I have Known in Petroleum Exploration and Production

Jonathan Carter

E.ON.

The physical world beneath our feet has been created by complex geological processes. Extracting the resources that our civilisation needs depends on solving the mathematical equations that describe how engineering systems interact with the natural environment. In this presentation we will will consider the four most important equations related to the extraction of oil and gas.

Multi-spectral characterisation of thalamic nuclei using 3T MRI

Veronica Corona

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The thalamus is one of the most complex structures in the human brain. It is considered the central relay station for nerve impulses because nearly all incoming sensory and motor information pass through the thalamus before being projected to the cortex. Thalamic changes have been related to several neurodegenerative diseases, including Parkinson?s disease, Alzheimer?s disease, multiple sclerosis and dementias. Some of these illnesses can be treated with surgery and deep brain stimulation. In this context, accurate delineation of gray matter thalamic regions is of increasing clinical importance. In addition, the study and identification of imaging biomarkers can be extremely beneficial to patients with neurological disorders, providing early diagnosis and determining short and long term disease progression.
New developments in in vivo imaging permit to resolve thalamic nuclei and to apply quantitative morphometric analysis. In this work, we aim to study the thalamus with high resolution MR imaging from a multi-constrast point of view. We highlight the contribution of QSM and MPRAGE images. We present a segmentation method for thalamic regions which exploits the information from the three contrasts. We use supervised learning to classify voxels in the images followed by a convex optimization approach to further improve the segmentation. The algorithm results in a robust localisation of thalamic structures, tested in different populations.

Scalable bifurcation analysis of nonlinear PDE

Patrick Farrell

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Computing the solutions u of an equation $f(u, \lambda) = 0$ as the parameter λ is varied is a central task in applied mathematics. The current state of the art algorithm for this problem, arclength continuation and branch switching, is very powerful but suffers from two major disadvantages. The first is that it attempts to compute only the part of the diagram that is continuously connected to the initial data; disconnected branches are overlooked. The second is that the linear algebraic subproblems required (determinant calculation and nullspace construction) are expensive and hard to scale to very large discretisations.

In this talk I will present an alternative algorithm, deflated continuation, that overcomes both of these disadvantages: it computes connected and disconnected diagrams, and scales to very large discretisations if a good preconditioner for $f_u(u, \lambda)$ is available.

From MASDOC to Enable

Pravin Madhavan

Enable Software.

Enable is a software development company which designs, builds and supports bespoke web software and mobile apps. The company is based in Stratford-Upon-Avon with a permanently employed UK-based team, working with the latest Microsoft .NET and complementary web technologies. During this presentation, I will talk about some of the projects I have been working on and delve into the technology stack I am involved with on a day-to-day basis by creating a simple project. Along the way, I will also talk about my transition from academia to industry.