Network science

Network science is a new way of looking at the world, writes Zoe Dunford of the Institute of Food Research. It can help solve complex problems from preventing the failure of networks such as the national grid, to spreading happiness.

This year's gathering of NetSci was organised at the Institute of Food Research, part-sponsored by BBSRC. It attracted 250 researchers from 26 countries.

IFR'S József Baranyi explained, "There are similarities in the way that cells, people, transport systems or websites are connected. If all types of networks evolve and behave in similar ways, we can start to understand their strengths and weak spots."

The conference focused on novel directions in network research within the biological and environmental sciences, computer and information sciences, social sciences, finance and business.

Freelance science writer John Whitfield said: "This is the first conference I've been to that makes me feel old. Much of the research deals with phenomena – Facebook! MySpace! iPhones! – that until now I've been more than happy to let pass me by. "Besides being the hippest meeting I've been to, it's also the broadest. Network studies are touching just about every discipline, because you can say general things about networks, whether the players are enzymes, genes, species in a food web, nerve cells, patients or their diseases, companies, politicians or countries."

Professor Nicholas Christakis from Harvard Medical School, one of the keynote speakers, presented research on the spread of happiness. He found that happy people cluster together on social networking sites and that the link is significant to three degrees of separation. So how happy you are is influenced by your social links to people you've never heard of and never met.

BBSRC provided funding to enable young researchers to attend, including Jose Marcelino from Newcastle University...

Stopping spreading: one link at a time

You'd think that shutting down airports or isolating cities would be the best approach to containing an emerging epidemic. However, such solutions, while effective, result in a huge disruption of air traffic.

A recent study from Newcastle University proposes that it is possible to control an outbreak by shutting down specific flight connections between airports or cities. These connections can be identified by measuring the relative contribution of each one to the spreading process. "Originally we were studying how to control the spreading of epilepsy in the brain," says Jose Marcelino who studies this approach as part of his PhD thesis. "Quickly our interest grew to other applications where the removal of major network nodes would lead to severe side effects."

Linking network structure and spreading dynamics is another application in the emerging field of network science, whose tools and modelling techniques developed for one field can be shared and used in other fields as well.

Marcelino, working in the group led by RCUK Academic Fellow Dr Marcus Kaiser (www.biological-networks.org), analysed spreading in a range of man-made networks, from the world's passenger flight connections and the internet to biological networks such as the primate brain connectivity. Through spreading simulations, the team tested several different measures for predicting the most critical edges. They found measures can already predict these edges. Several measures were able to identify the most important connections. For example, connections between airports with different neighbours often signify airports in different network clusters corresponding to different geographical regions. Cutting these edges helps in containing the epidemic within one region. In a similar way, activation might be contained within the starting region of a epileptic seizure by identifying critical fibre tracts for spreading.