Focus on research: Computer scientist dr. Paola Grosso

Photo: Bob Bronshoff

Ever sat in front of the screen waiting for a YouTube clip that's taking forever to load? Annoying, but certainly nothing serious compared to the problems Paola Grosso deals with on a daily basis. The Italian computer scientist develops ingenious network infrastructures designed to transfer enormous quantities of scientific, medical and media data. Streaming a film in real time from server to cinemas? It's all just a matter of time.

Future internet

Photo: Bob Bronshoff

As a senior researcher (and soon to be assistant professor) at the System and Network Engineering group of the Informatics Institute, Grosso is currently developing high-speed optical networks. Her work centres on 'future Internet', a term used by computer experts to describe a more reliable, rapid and secure form of Internet. This future Internet will have to support more types of data than its current incarnation, Grosso explains. This will be necessary in order to satisfy increasingly high and diverse user requirements. 'A good example would be the creative industry. Hollywood films, for instance, will have to be transferred from the set to the sound dubbing studio in high resolution. That will involve a huge number of bytes.' The number of Internet users is also on a steady upswing, she continues. 'In an increasing number of cases, data is now sent from 'one to many', as we call it, rather than from one individual user to another. Finally: the real time aspect is also becoming increasingly important: Internet television, video conferencing, multimedia applications, gaming.'

Path-finding models for an efficient data circuit

In order to process these various types of data, we need a system that can transfer different data types in different ways. Under the current network infrastructures, all these data are forced to travel over the same pathways. 'The big and small data streams have a disastrous effect on one another. I suppose you could compare it to a motorway with trucks and passenger cars: this mix ends up slowing everyone down.' In order to resolve this problem, the data packets belonging to large data streams – the trucks, in other words – are converted at the source into light of one specific colour or wavelength. These light colours are then sent through the fibre optic infrastructure along different individual

pathways, Grosso explains. ‘There are lots of different network segments around the world connected to intersections, known as the next generation of Internet exchanges. We are developing technology that will allow you to assign a specific circuit or colour to selected data streams, so that they can be transported through a system of fibre optic cable and switches.’

The Global Lambda Integrated Facility (GLIF) visualization. Click play to start the movie.

One factor complicating the development of these circuits is the availability of network segments, Grosso explains. On a global scale, a vast amount of data is transferred through various networks, which preferably do not interfere with one another. In addition, networks and peripherals do not always use the same technology. Grosso and her colleagues must factor in these sorts of problems as they develop the path finding models needed to calculate optimally efficient data circuits.

Refer to
Website GLIF

The semantic web

Grosso’s group leads the way when it comes to use of the semantic web. This technology pushes the envelope, with computers applying and interpreting semantic information in their calculations. ‘We provide them with concepts that contain more information than normal data. Computers can identify connections between these concepts and use the resulting information to reason. This yields unexpected new insights.’

Grosso is especially enthusiastic about the *Green Clouds* project, an application of this technology recently launched in collaboration with the group headed by VU University’s Professor Bal. ‘We’re trying to develop a more environmentally-friendly computer environment. In order to achieve this, we’ve added the concept of energy consumption to the semantic data used to determine optimal data routes and computation possibilities.’ Various aspects are key in this regard: the location of the transmitted data and the electricity consumption of the computers being used. Grosso: ‘We need to ask ourselves what would be smarter: leaving your own computer running, or using a highly energy-efficient computer in a cloud somewhere on the other side of the world?’

Virtualisation

Grosso and her fellow network scientists have also adopted virtualisation, common in other area of computer science. When applied to computers virtualization implies that calculations are no longer linked to a specific physical machine, but are conducted by a virtual system running on a physical station.

Grosso: ‘In a similar manner we’re currently building ‘virtual’ networks with virtual routers and switches that operate independently and can be made available to users. We develop the models that allow others to make optimal use of these systems.’

Link to day-to-day practice

Grosso spends a great deal of time collaborating with others, she explains. Both scientists and end-users are desperate for improved infrastructures and knowledge on how to modify edge devices such as routers and other processors in order to cope with the more intensive data transport. One project that combines these two aspects is Cinegrid Amsterdam a collaboration between the UvA and among others partners such as the Waag Society, SARA and SURFnet. Together, they work from Amsterdam to develop a network and practical applications for 4K technology. The resulting images are four times as sharp as HDTV and the sound is uncompressed – a rather data-intensive technology, in other words. The project melds technology, art, education and science.

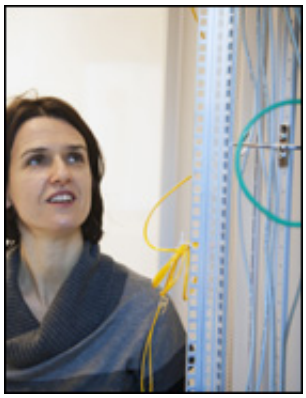

Photo: Bob Bronshoff

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Website Cinegrid Amsterdam

This link to day-to-day practice is characteristic of Grosso’s work, she explains. ‘We’re not selling anything here, but we do keep an eye on the outside world. We can work with the industry players involved in the major projects.’ That same degree of practical applicability is also reflected in the curriculum, according to Grosso. ‘We teach the really fundamental courses on network architecture and protocols, but a lot of our students do end up in the commercial sector.

‘I studied and earned my doctorate in experimental physics, so I love fundamental science. But my field of research has so many immediate applications, and this I find very motivating.’

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