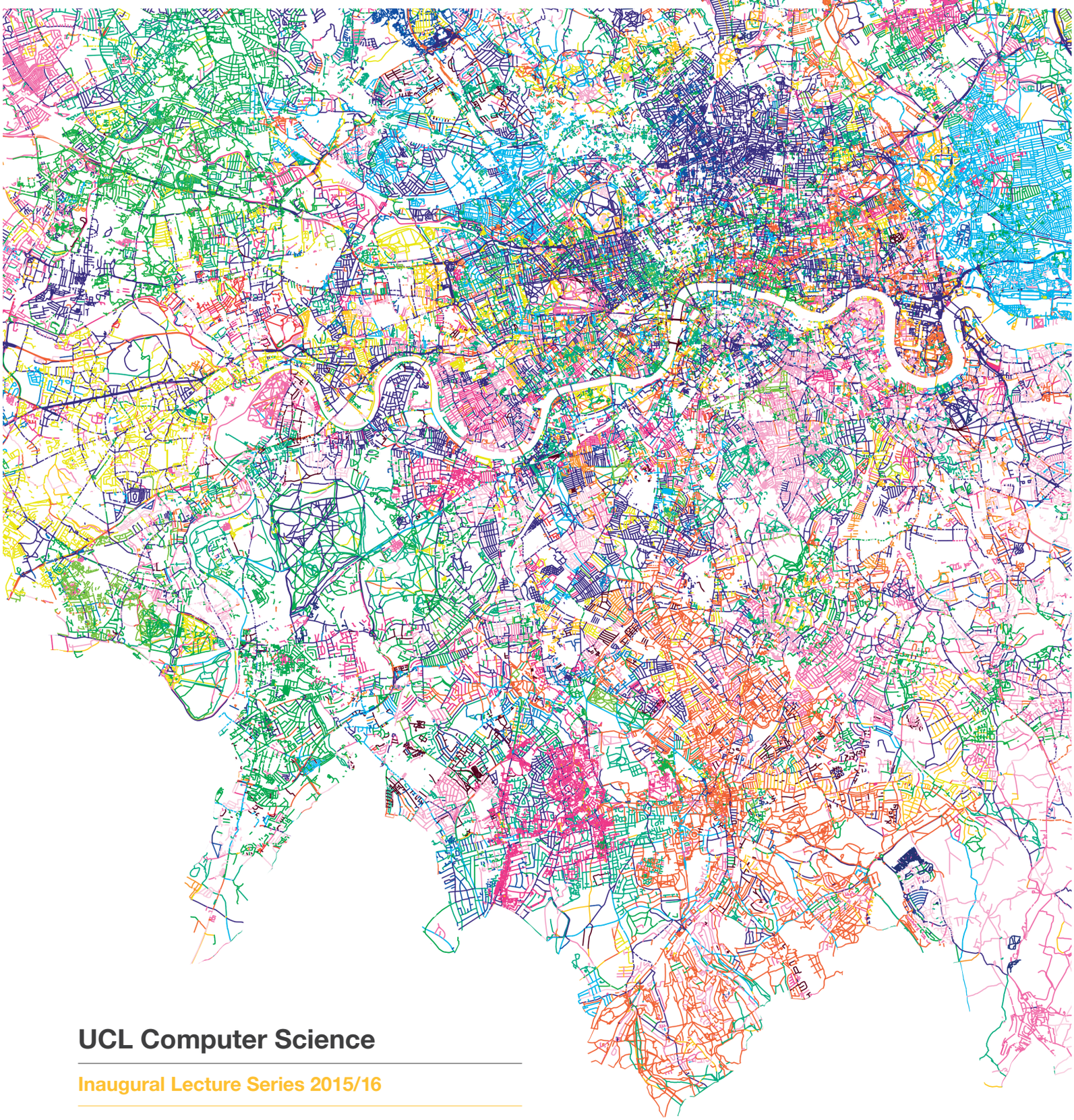
UCL DEPARTMENT OF COMPUTER SCIENCE



# UCL Computer Science

## Inaugural Lecture Series 2015/16

UCL ENGINEERING
Change the world

# A message from **John Shawe-Taylor**

**Professor of Computational Statistics & Machine Learning**

Head of UCL Computer Science

**I am delighted to announce our programme of Inaugural Lectures for the forthcoming year. Our lectures will be delivered by six newly appointed professors, and provide a wonderful opportunity for them to showcase and celebrate their research with a wide audience across UCL, academia and beyond.**

The scale of our programme is impressive – but so too is the diversity. It is especially pleasing that 50% of our newly promoted Professors are women, which is testament to the department's approach towards supporting women in computing.

The scope of the six lectures and subjects they raise reflect UCL Computer Science's deep, lasting and sustained impact across a range of areas; from physical pain management to cryptography, via 3D modelling and smart cities planning. The range of research topics covered is equally diverse and exciting.

I hope you will join me in congratulating our newly appointed professors and celebrating their work and contribution to UCL Computer Science.

# A message from **Yvonne Rogers**

**Professor of Interaction Design**

Deputy Head of Department

**It is great to see so many women being promoted to professors in one year. This is an amazing achievement, particularly given how so few female professors there are in Computer Science worldwide.**

But more importantly is that it is an equal number of women and men being promoted this year. This is what we should be aspiring to and it makes me very proud. I hope you can join us for the '50:50' class of 2016 Inaugural Lectures – which are intended to be inspiring, topical and accessible to all.

# Programme

## Inaugural lecture series 2015/16

### Nadia Berthouze

**Bringing affect into technology: the case of physical rehabilitation**
Wednesday 10 February

### Tomaso Aste

**Predictive modeling for a complex world: a data-driven perspective**
Wednesday 16 March

### Licia Capra

**Urban Computing: From Smart Cities to Engaged Citizens**
Wednesday 4 May

### Tim Weyrich

**Digital Reality: Visual Computing Interacting With The Real World**
Wednesday 8 June

### Lourdes Agapito

**Capturing vivid 3D models of the world from video**
Wednesday 5 October

### Jens Groth

**Zero-Knowledge Proofs**
Wednesday 2 November

A drinks reception will follow all lectures.

# Bringing affect into technology: the case of physical rehabilitation

**Nadia Berthouze**

Professor of Affective Interaction & Computing

**Emotions and affective states more generally play an important role in people's life, including when they interact with increasingly pervasive technology. Yet, for a long time, technology has failed to take them into account. Nadia's research aims to design technology that is capable of recognising what we feel so as to provide us with relevant support. This talk will focus on one application domain: technology in chronic pain physical rehabilitation. Chronic pain brings with it many affective states in addition to frustration or boredom at engaging in repetitive exercises.**

Those include low self-esteem for the new body we have to accept, fear and anxiety of injuring oneself, and low perceived self-efficacy modulated by attention to pain. Whilst gamification has been found to mitigate the more boring aspects of physical rehabilitation, other affective states are still mostly overlooked resulting in low adherence to the therapy program and low transfer to everyday functional capabilities. In this talk, Nadia will present her investigations into the affective barriers to physical rehabilitation in chronic pain and the needs that technology should address to be effective. Nadia's main goal is to help people learn to self-manage their condition with a more positive perception of their body and capabilities.

Nadia leads the Affective Computing and Interaction group within the UCL Interaction Centre. She pioneered the study of body movement and touch behaviour as modalities for affective automatic recognition and modulation in technology-mediated scenarios (games, health sector). Her work has gone beyond acted emotions by investigating naturalistic affective expressions such as laughter and pain. In the context of full-body game design, she has shown how body movement can be used as a way to steer the experience of the player.

She has proposed a new conceptual framework for designing physical rehabilitation technology in chronic pain that takes into account psychological progress and not just physical improvement. This has led to the implementation of a novel wearable device that received various awards. She has been invited to write chapters for prestigious handbooks (Oxford Handbooks, APA Psychology series), to give a TEDxStMartin talk and being a keynote speaker for various academic and industry-led conferences. She has been PI and Co-I in various UK, EU and Japan funded projects. She is part of the EU- UBI-HEALTH Network that sets roadmaps for ubiquitous health technology.

**www.cs.ucl.ac.uk/staff/n.berthouze**

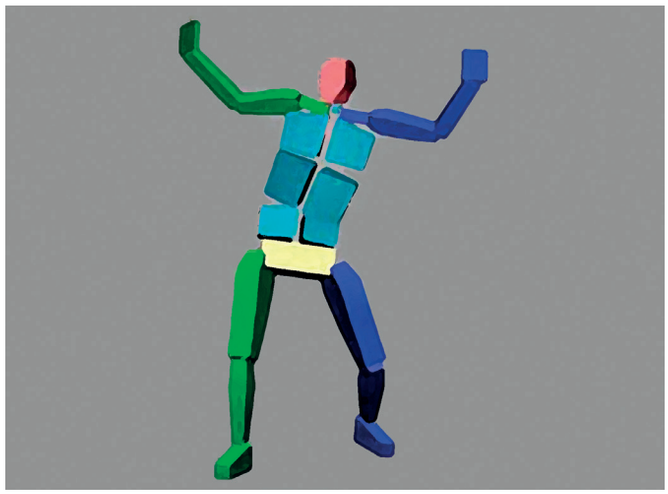


Image above: Taken from the UCL Interaction Centre Database of Affective Postures and Body Movements, using VICON motion capture system.

# Predictive modeling for a complex world: a data-driven perspective

**Tomaso Aste**

Professor of Complexity Science

**We all experience complexity in everyday life where simple answers are hard to find and the consequences of our actions are difficult to predict. Understanding and modeling the complex nature of things, peoples and societies have become a crucial scientific challenge with great practical impact. The current big-data revolution has provided unprecedented access to large amount of data for modeling, forecasting and testing complex systems. However, analyzing, understanding, filtering and making use of such a large amount of data have also become a challenging activity across science, industry and society.**

Tomaso's approach to the solution of these challenges has been to combine network theory, statistical physics, data science, multiscale analysis and computational methods to unwind complexity and produce models that are capable to make reliable predictions.

Tomaso graduated in Physics at the University of Genoa and has a PhD in Material Sciences from Politecnico di Milano. He is Head of the Financial Computing and Analytics Group at UCL, Director of the UCL Centre for Blockchain Technologies, Programme Director of the MSc in Financial Risk Management, Vice Director of the Centre for Doctoral Training in Financial Computing and Analytics, Member of the Board of the ESRC funded LSE-UCL Systemic Risk Centre. He collaborates with many major financial institutions, with regulators and with a large number of start-ups and businesses in the FinTech and digital economy area.

Prior to UCL, Tomaso was Reader at the School of Physics, University of Kent and before Associate Professor at the Department of Applied Mathematics at The Australian National University. He was Marie Curie Fellow at the University of Strasbourg and he had been associated with several institutions including University of Oxford, Imperial College and The University of Genoa.

**www.cs.ucl.ac.uk/staff/tomaso_aste**

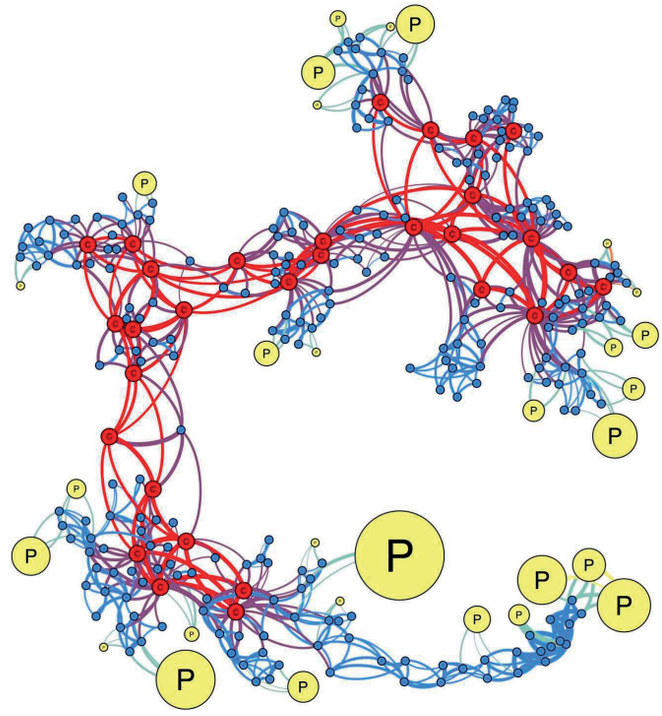


Image above: The selection of a portfolio of peripheral stocks from a study of the distribution of financial risk by means of information filtering networks.

# Urban Computing: From Smart Cities to Engaged Citizens

**Licia Capra**

Professor of Pervasive Computing

**Urbanization is progressing fast, and it is estimated that by 2050 almost 70% of the total global population will live in cities. This process is expected to bring important advantages, including more efficient running of public services and better living standards for its citizens. However, if not properly managed, it risks aggravating existing issues, such as traffic congestion, environmental pollution, and social inequality.**

Urban computing is an interdisciplinary research area that aims to help manage this complex process. By acquiring, integrating, and analysing large amounts of heterogeneous data, generated in urban spaces by a diversity of sources, such as sensors, devices, vehicles, buildings, and humans, it aims to derive a rich knowledge about the functioning of our cities, and use it to improve the quality of life of its residents. In this talk, Licia will describe her past and ongoing investigations of a variety of urban data sources. Drawing inspirations from different fields, including urban planning and economics, she will illustrate the models she has built to understand the nature of urban phenomena, with specific applications to public transportation, the environment, and social interactions.

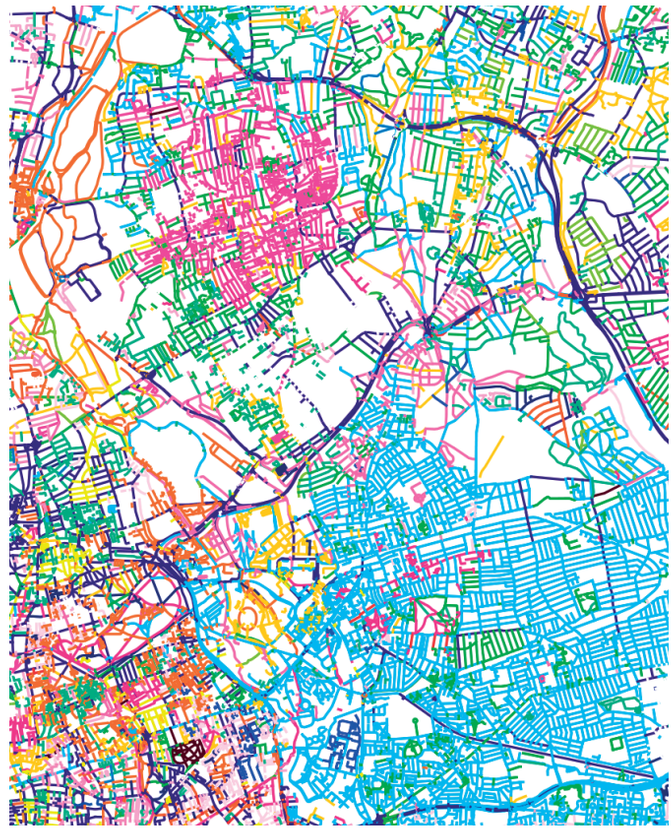


Image above: OpenStreetMappers of London. Data: © OSM contributors/OS © Crown copyright & database right 2010–14.

Licia obtained an MSc degree in Computer Science from the University of Bologna in 2000, and a PhD in Computer Science from UCL in 2003. After a period of postdoctoral work in the Software Systems Engineering Group at UCL Computer Science, she started as Lecturer within the same department in 2005. Licia Capra is now Professor of Pervasive Computing.

Her research originally investigated what programming abstractions, algorithm libraries, and middleware systems to offer application developers, so to ease ubiquitous computing application development. She then shifted focus from programmers to end users of such applications, with the aim to provide them with more positive, engaging and fulfilling experiences when interacting with pervasive technology in their daily life. To achieve this, she has been analysing and modelling human behaviour over space and time, using a variety of “digital traces” that we leave behind, both online and offline. She has been using these models in particular to understand and predict urban phenomena. Licia Capra has been co-PI of the Intel Collaborative Research Institute on Sustainable Connected Cities since October 2012, and a co-director of the UCL Urban Laboratory since 2015.

**www.cs.ucl.ac.uk/staff/l.capra**

# Digital Reality: Visual Computing Interacting With The Real World

**Tim Weyrich**

Professor of Visual Computing

**The increasingly ubiquitous availability of high-quality digital cameras enables low-cost visual capture and digitisation of real-world objects and phenomena; at the same time, physical output devices, from high-definition screens to computer-controlled manufacturing, are becoming commonplace. This development bears the promise of an even tighter integration of computers into traditional workflows, seamlessly transitioning between the physical and the digital realm. In practice, however, technical off-the-shelf solutions are rarely sufficient to enter previously non-computerised domains.**

Tim's work focuses on developing novel representations, algorithms and workflows to open up visual computing (capture, modelling, manipulation and replication of visual and geometric entities) for novel application domains. This talk presents such bespoke developments in a number of areas, including special-effects, cosmetics, mechanics, sculpture and architecture, as well as cultural-heritage preservation, discussing how through careful analysis of traditional problem domains and workflows visual computing can make a difference in previously unexpected ways.

Tim is Professor of Visual Computing in the Virtual Environments and Computer Graphics group at UCL Computer Science; and Deputy Director of the UCL Centre for Digital Humanities. Tim represents UCL in teaching matters within the European network EIT Digital, and is also course director of the related MSc ICT Innovation.

Prior to coming to UCL, he was a Postdoctoral Teaching Fellow of Princeton University, working in the Princeton Computer Graphics Group, a post that Tim took after having received his PhD from ETH Zurich, Switzerland, in 2006. Tim's research interests are appearance modelling and fabrication, point-based graphics, 3D reconstruction, cultural heritage analysis and digital humanities.

**www.cs.ucl.ac.uk/staff/t.weyrich**

Image above: The Great Parchment book, a crucial historical text documenting the City of London's role in 17th century Ulster that was previously unreadable for over 200 years due to fire damage, now generated as a 3D model to be viewed at archival resolution.

# Capturing vivid 3D models of the world from video

**Lourdes Agapito**
Professor of 3D Vision

**As humans we take the ability to perceive the dynamic world around us in three dimensions for granted. From an early age we can grasp an object by adapting our fingers to its 3D shape; we can understand our mother's feelings by interpreting her facial expressions; or we can effortlessly navigate through a busy street. All of these tasks require some internal 3D representation of shape, deformations and motion.**

Building algorithms that can emulate this level of human 3D perception has proved to be a much harder task than initially anticipated. While some degree of success has been achieved when the scene observed by a camera is static or "rigid", inferring the 3D geometry of the vivid moving real world is still in its infancy. This challenge has fascinated Lourdes throughout her research career. In this lecture she will show progress from her early systems which captured sparse 3D models with primitive representations of deformation towards our most recent algorithms which can capture every fold and detail of hands, faces and clothes in 3D using as input video sequences taken with a single consumer camera. There is now great short-term potential for commercial uptake of this technology, and Lourdes will show applications to robotics, augmented and virtual reality and minimally invasive surgery.

Professor Lourdes Agapito obtained her BSc, MSc and PhD (1996) degrees from the Universidad Complutense de Madrid (Spain). She held an EU Marie Curie Postdoctoral Fellowship at The University of Oxford's Robotics Research Group before being appointed as a Lecturer at Queen Mary, University of London in 2001. In 2008 she was awarded an ERC Starting Grant to carry out research on the estimation of 3D models of non-rigid surfaces from monocular video sequences. In July 2013 she joined UCL Computer Science as a Reader (Associate Professor) where she leads a research team that focuses on 3D dynamic scene understanding from video.

Lourdes is Program Chair for CVPR 2016, the top annual conference in computer vision; in addition she was Programme Chair for 3DV'14 and Area Chair for CVPR'14, ECCV'14, ACCV'14 and Workshops Chair for ECCV'14. She has been keynote speaker for CVMP'15 and for several workshops associated with the main computer vision conferences (ICCV, CVPR and ECCV). Lourdes is Associate Editor for IEEE Transactions on Pattern Analysis and Machine Intelligence (PAMI), a member of the Executive Committee of the British Machine Vision Association and a member of the EPSRC Peer Review College.

**www.cs.ucl.ac.uk/staff/l.agapito**

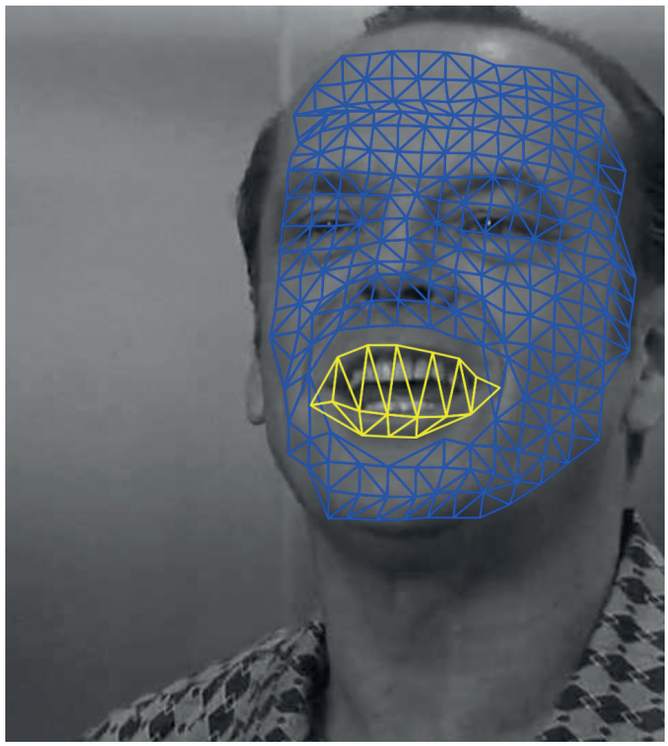


Image above: A Variational Approach to Video Registration with Subspace Constraints, R. Garg, A. Roussos and L. Agapito, 2013.

# Zero-Knowledge Proofs

**Jens Groth**
Professor of Cryptology

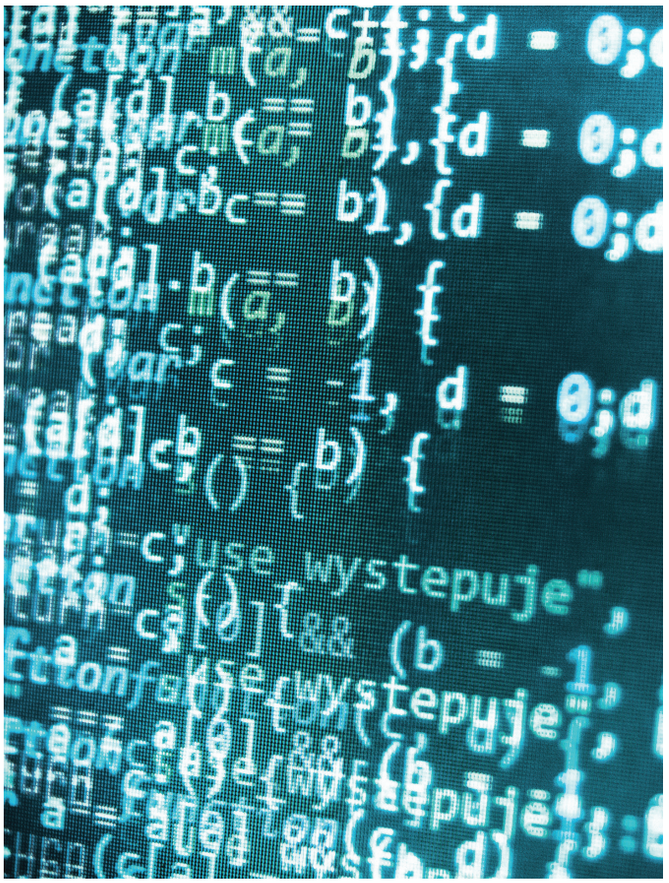
**Zero-knowledge proofs enable a prover to convince a verifier that a statement is true without revealing anything else, in particular they reveal no private information. The combination of verification and confidentiality make them a fundamental and widely used building block in cryptography.**

There has been a number of exciting developments in recent years leading to tremendous improvements in efficiency. Jens will give an introduction to zero-knowledge proofs and outline some of the ideas that go into recent constructions of efficient zero-knowledge proofs.

Jens is the Director of UCL's Academic Centre of Excellence in Cyber Security Research and Professor of Cryptology at UCL Computer Science. He is among the 20 most published authors worldwide at the top cryptology conferences ASIACRYPT, EUROCRYPT and CRYPTO over the last decade.

Jens's work has revolutionized the area of zero-knowledge proofs with the invention of practical pairing-based non-interactive zero-knowledge proofs, which was recognized early on with the UCLA Chancellor's Award for Postdoctoral Research in 2007. His research has been funded by several EPSRC grants and an ERC Starting Grant on Efficient Cryptographic Arguments and Proofs.

**www.cs.ucl.ac.uk/staff/j.groth**



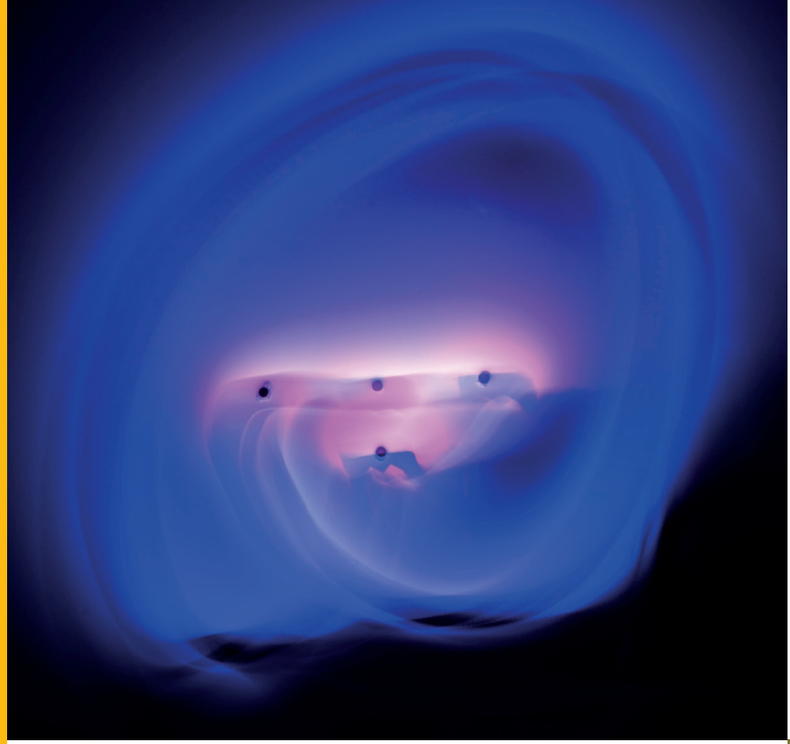
## About UCL Computer Science

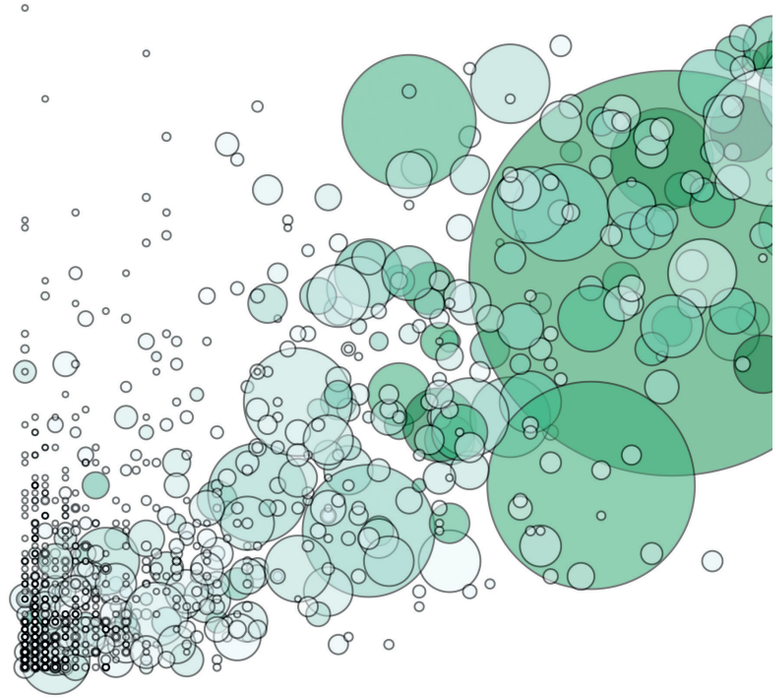
**The 2014 Research Excellence Framework (REF) evaluation ranked UCL 1st for Computer Science in the UK. 61% of our research work is now rated as 'world-leading', and 96% 'internationally excellent'. Our work is interdisciplinary, across 11 research groups and 8 centres, including the Centre for Health Informatics & Multiprofessional Education (CHIME), Biomedical Physics & Biochemical Engineering, and the Centre for Medical Image Computing (CMIC).**

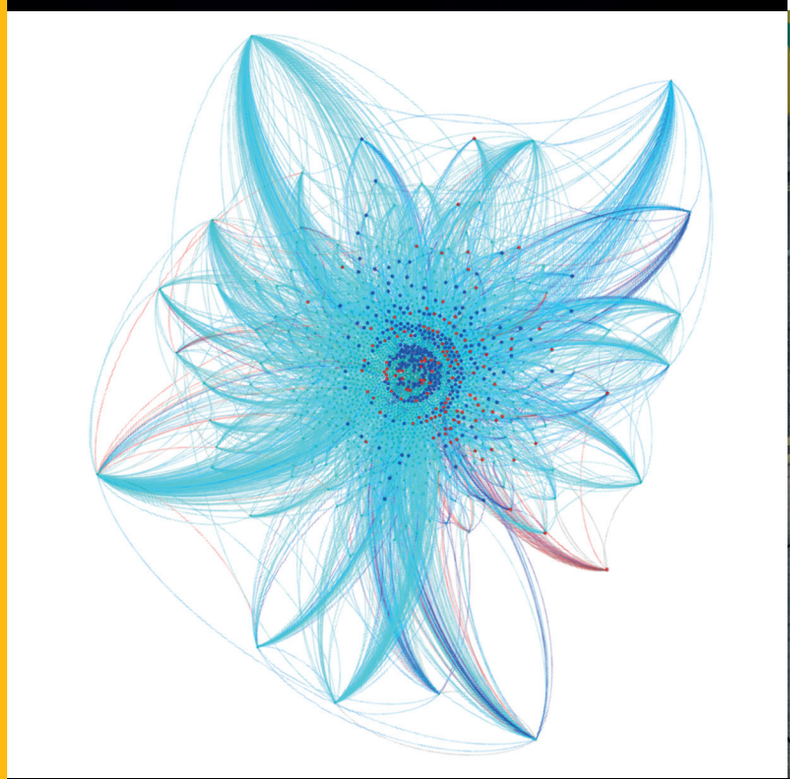
Our research has made a deep, lasting and sustained impact on today's society. Code written at UCL is used across all 3G mobile networks for instant messaging and videoconferencing; medical image computing has led to faster prostate cancer diagnosis and safer neurosurgery; and our human-centred approach to computer security has transformed the UK government's delivery of online security.

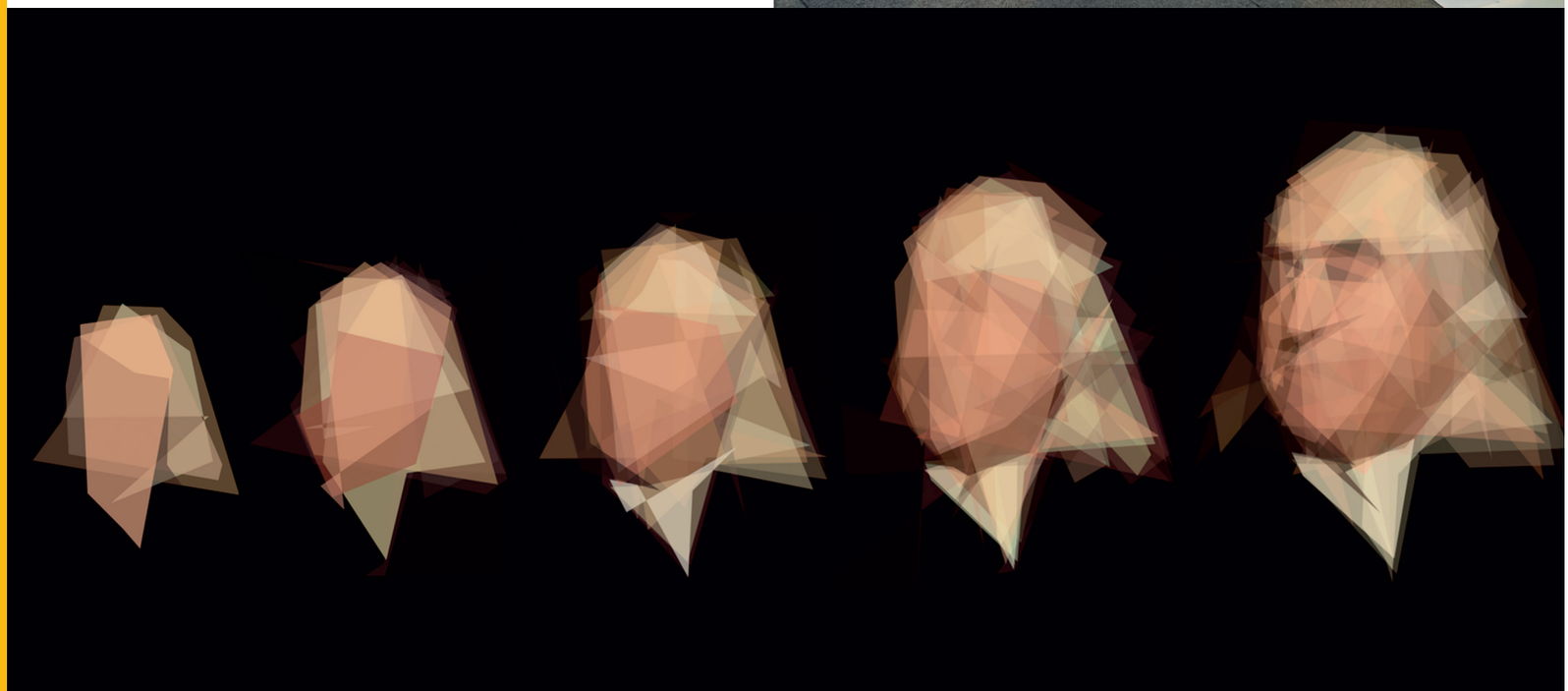
UCL Computer Science has always had a big impact on computing; we established the first connection to the precursor of the internet outside the U.S, and we continue to change lives with computers.

Images on opposite page – UCL Computer Science 2014/15 'Research Images as Art' Doctoral School competition entries. Clockwise from top left: Rae Harbird, Martin Dittus, Lisa Koeman, Yue Jia, Guido Previde. For more information please visit: **www.grad.ucl.ac.uk/comp/2014-2015/research/gallery/bydept.pht?department=41** 









**Find us online** www.cs.ucl.ac.uk

**Like us on Facebook** www.facebook.com/UCLCS.Home

**Follow us on twitter** www.twitter.com/uclcs