CASA Smart Cities: bridging physical and digital

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#casaconf

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Cover image: Evolution of London's road network by Kiril Stanilov and Paolo Masucci



Image right: CASA City: Advances in procedural city software represent an emerging new way to dynamically model, build and visualise urban form.

CASA Smart Cities: bridging physical and digital

Friday 20th April 2012: Senate House, Malet Street, London WC1E 7HU

09.00-09.30 Registration

01 09.30-09.50 Smart Cities: an emerging research agenda Professor Michael Batty CBE, CASA 02 09.50-10.20 Keynote speech: Senseable Cities Professor Carlo Ratti, Senseable City Lab, MIT

10.20-10.30 Q & A

03 10.30-11.00 Understanding transport networks: demaind and supply Dr Jon Reades, Dr Joan Serras, CASA

11.00-11.30 Refreshments, networking and exhibits

04 11.30-12.00 Understanding bike share schemes Dr James Cheshire, Oliver O'Brien. CASA

05 12.00-12.30 A model of the London riots Toby Davies, Dr Hannah Fry and Professor Sir Alan Wilson, Enfolding - CASA

06 12.30-13.00 Sensing the subjective city George MacKerron, CASA

13.00-14.00 Lunch, networking and exhibits

07 14.00-14.30 Data stores, real-time data, and the crowd Steven Gray, Richard Milton, CASA

08 14.30-15.00 Endowing the city with memories Dr Ralph Barthel, Dr Andrew Hudson-Smith, Dr Duncan Smith, Dr Martin de Jode, CASA

09 15.00-15.30 CityDashboard: your city in real-time Oliver O'Brien, CASA

15.30-16.00 Refreshments, networking and exhibits

10 16.00-16.50 Panel session Recorded for the Global Lab podcast

16.50-17.45 Wine reception, networking and exhibits









About CASA

The UCL Centre for Advanced Spatial Analysis (CASA) is a unit in the Bartlett Faculty of the Built Environment (The Bartlett). The Director is Dr Andrew Hudson-Smith and the Chair of the Management Board is Professor Michael Batty, with executive board members consisting of Professor Sir Alan Wilson and Sonja Curtis.

CASA's focus is to be at the forefront of what is one of the grand challenges of 21st Century science: to build a science of cities from a multidisciplinary base, drawing on cutting edge methods, and ideas in modelling, complexity, visualisation and computation.

Our current mix of architects, geographers, mathematicians, physicists, planners and computer scientists make CASA a unique department within UCL.

Our vision is to be central to this new science, the science of smart cities, and relate it to city planning, policy and architecture in its widest sense. The focus is on advancing the state of the art through research complemented by graduate study, undergraduate teaching, consultancy and distance learning.







ANALOGIES: Analogues of Cities

In September 2010, CASA was awarded funding from the Engineering and Physical Sciences Research Council [EPSRC] to develop a series of key analogies between the way cities function and various electrical, mechanical, biological and human systems such as fluid flows, potential energies and electricity, and dynamic mechanisms, exploring these analogies in a depth that has not been possible hitherto.

With a veritable cornucopia of such shared abstractions we felt it was opportune to begin to assemble these and formalise them so that, in the first instance, they could inform as to the best ways forward in developing the many models that are used to examine the functions and structure of cities.

Deepening these analogies was our first quest. Our second was to translate these analogies into models or analogues that we could realise in tangible form, using the term tangible to span the material and the digital. The process of constructing such analogues is guite new. In the past, these have been developed in an ad hoc manner but in this project we developed them in symbolic terms as far as we could and then translated them into physical and digital analogues. The third quest was to locate these in an environment that users could learn from improving their understanding, their problem solving capabilities and the power of their designs. We have created a mini-media exhibition we are calling "An Outlook Tower for the 21st Century" after the example of Sir Patrick Geddes who was an early exponent of this mode of participation.

Smart Cities: an emerging research agenda

01

Smart cities involve hardware, software, data and 'orgware' that are being developed for what were once called 'wired cities'. We see these developments mainly in the delivery of services, such as transport services, to urban populations. They provide radically new data sources with respect to routine behaviours, with the potential to provide us with new ideas and new horizons for improving many aspects of urban social and economic life. CASA researchers are working on several projects related to this mission. This talk provides some orientation for the rest of the day, elaborating first the wider idea of how cities are becoming 'smart', and then more specifically introducing tools for online mapping, participation, modelling and tagging that define this new agenda for research and practice.

Professor Michael Batty CBE is, by

training, an architect-planner and geographer. He is currently Professor of Planning at University College London where he is Chairman of the Management Board of CASA. Previously (1990-1995) he was Director of the NSF National Center for Geographic Information and Analysis (NCGIA) in the State University of New York at Buffalo and from 1979 until 1990, he was Professor of City and Regional Planning in the University of Cardiff. His research work involves the development of computer models of cities and regions, and he has published many books and articles in this area, the most recent being Cities and Complexity (MIT Press, Cambridge, MA, 2005). He is editor of the journal Environment and Planning B: Planning and Design. He was made a Fellow of the British Academy in 2001, awarded a CBE in June 2004 and elected as Fellow of the Royal Society (FRS) in 2009. www.complexcity.info



Senseable Cities

Your phone and your car now have as much processing power as your desktop computer did ten years ago. Knit all of these distributed systems together with real-time data, feedback, and visualisation, and you have the foundations of a smarter city. For the past decade the MIT Senseable City Lab has been exploring how these developments are changing the way that we interact with our built environment - from electronically tagging trash to expose our cities' hidden 'removal-chain' to developing real-time, in-car user interfaces able to predict congestion and highlight relevant local information at your destination... as you pull out of your driveway. In addition, data from telecommunications systems are being used to map out the social, economic and environmental impacts of our increasing mobility. This keynote will present highlights from our work on smarter cities and offer predictions for where the next decade of innovation will take us.

> Professor Carlo Ratti is an architect and engineer by training who practices in Italy and teaches at MIT. where he directs the Senseable City Lab. He graduated from the Politecnico di Torino and the École Nationale des Ponts et Chaussées in Paris, later earning his MPhil and PhD at the University of Cambridge, UK. Carlo holds several patents and has co-authored over 200 publications: a regular contributor to the architecture magazine Domus and the Italian newspaper II Sole 24 Ore, he has also written for the BBC, La Stampa, Scientific American and The New York Times. His work has been exhibited worldwide at venues such as the Venice Biennale and the MoMA in New York and his 'Digital Water Pavilion' at the 2008 World Expo was hailed by Time Magazine as one of the Best Inventions of the Year. In 2010 Blueprint Magazine selected him as one of the '25 People Who Will Change the World of Design' and in 2011 Fast Company named him as one of the '50 Most Influential Designers in America'. Carlo presented at TED 2011 and is currently a program director at the Strelka Institute for Media, Architecture and Design in Moscow and a curator of the 2012 BMW Guggenheim Pavilion in Berlin.

> Image: Visualising Oyster Card Data -Touch Ins and Touch Outs on the London Underground and DLR [Contains Ordnance Survey data © Crown copyright and database right 2012, OSM data CC-By-SA OpenStreetMap contributors and Oyster data © Transport for London].

Understanding transport networks: demand and supply

With the increasing availability of usage and scheduling data for London and Great Britain, we are now in a position to begin exploring the interactions between the demand for, and supply of, public transit. How do disruptions affect the user experience? How much disruption can a transport network handle? Ongoing research is beginning to allow us to quantify this and other aspects of network load, shedding light on the resilience of cities to unexpected events. We will present an introduction to this dynamic at the local and national levels.

03

Dr Jon Reades holds a PhD from UCL's Bartlett School of Planning, and an undergraduate degree from Princeton University. More recently, he has received funding to collaborate with researchers at CASA and within UCL's health and energy groups to pursue mobile application development and visualisation work with a view to improving health outcomes for patients suffering from activity-triggered illness.

Dr Joan Serras holds a degree in Industrial Engineering from the University of Girona and a PhD in Engineering Design for Complex Transportation Systems from the Open University. He worked as a Research Assistant at the Open University prior to joining CASA in 2010 as a researcher on our SCALE project which explores the relationship between residential location and travel choice at the level of cities. www.simulacra.info



Understanding bike share schemes

Bicycle sharing schemes are becoming increasingly popular in towns and cities around the world, as a cheap, efficient, and healthy means of navigating dense urban environments. Using data on approximately 3 million individual trips from the London scheme, and similar data from other cities, we explore the characteristic spatial and temporal usage flows that arise. These, in turn, can reveal the nature of the journeys undertaken, and unearth the differing user demographics and intentions throughout the scheme. Knowledge of such patterns and characteristics has a range of both practical and research applications.

Dr James Cheshire is a lecturer at CASA specialising in GI Systems and Science which he teaches to the MRes in Advanced Spatial Analysis and Visualisation. His expertise is in spatial statistical analysis, in map visualisation, and in large spatial databases.

www.spatialanalysis.co.uk

Oliver O'Brien joined UCL in 2008 as a researcher/ programmer, having previously been a financial software developer, and has worked with spatial interaction models for school-to-university flows, online choropleth maps for census datasets, creation of web mapping tools and city data visualisations. His research interests include open-source GIS, neogeography, cartography and information visualisation. He coauthors the Mapping London blog with Dr James Cheshire and also contributes to the OpenStreetMap project. **oliverobrien.co.uk** and mappinglondon.co.uk

> Image: Docking stations of the Barclays Cycle Hire bike sharing scheme in central London. The Isle of Dags is at the top. Red circles show full docking stations and blue ones show empty ones, for a typical weekday lunchtime.

A model of the London riots

In August 2011, several areas of London and other cities in the UK experienced episodes of large-scale disorder, comprising looting, rioting and violence. Much of the subsequent discourse has concentrated on the adequacy of the police response, specifically in terms of the resources available and tactics used. In this talk, we present a mathematical model of the disorder which can be used to examine the effect of varying policing arrangements. The model is capable of simulating and replicating the general emergent patterns of the events and focuses on three fundamental aspects: the apparently-contagious nature of riot participation: the relative positioning of suspect addresses and riot locations; and the deterrent effect of the police. We use the model to demonstrate that the spatial configuration of London meant that some areas were naturally at higher risk than others, implying the importance of spatial considerations when planning for such events. We also investigate the consequences of varying police numbers and reaction time for the outcome of such an event, which has the potential to guide policy in this area.

Toby Davies is a PhD student on UCL's SECReT program who is affiliated with the ENFOLDing project where his research interests include the use of complex systems methods to model the spatio-temporal patterns of security-related systems.

Dr Hannah Fry is trained as a mathematician and holds a PhD in Fluid dynamics. She works within the ENFOLDing project on the Complex Systems modelling workstream, focusing particularly on the analysis and improvement of existing complexity methods, and the creation of novel techniques.

Professor Sir Alan Wilson is the Principal Investigator of the ENFOLDing project. From an early background in Mathematics and Theoretical Physics, he has pioneered the use of spatial interaction models for the description of regional and urban systems. www.enfolding.blogs.casa.ucl.ac.uk





Sensing the subjective city

06

Links between subjective wellbeing and the urban environment are of potentially widespread interest, but existing quantitative evidence remains scarce. Addressing this issue, the Mappiness project signals participant volunteers at random moments. presenting a brief questionnaire while using satellite positioning (GPS) to determine their precise geographical coordinates. Associating response locations with objective spatial data, I estimate models relating happiness to environmental characteristics, while controlling for activity, companionship, time of day, day of week and more. I present initial evidence regarding relationships between happiness and different habitat types, weather conditions, and air quality levels. I suggest that the novel geo-located experience sampling methodology employed will in future provide valuable insights for architecture and planning, environmental policy-making, psychology, health, and beyond.

George MacKerron is a CASA Research Associate focusing primarily on two broad topics of research: (1) subjective wellbeing; and (2) environmental sustainability, in respect both of local environmental quality and global climate change and carbon emissions.

George created the Mappiness study as part of his doctoral research at the London School of Economics. The study, which is ongoing, uses a mobile app to investigate how happiness varies according to an individual's immediate environment, and has generated a longitudinal data set of over 3 million responses from 45,000 participants. www.mappiness.org.uk

Image: Mappiness iPhone App

Data stores, real-time data, and the crowd

Technological advances are generating data at an everincreasing rate. Developing tools and methods to keep pace with this deluge is essential. We present tools we have developed to simplify working with geospatial data, assisting the crowd-sourcing and visualisation of data not only through the web but also on mobile devices. We demonstrate GEMMA — the Geo-spatial Engine for Mass Mapping Applications. We present an automatic mapping technology that can visualize every geographic dataset on the London Datastore, and show how data-mining techniques can extract additional information. We present ANTS — Adaptive Networks for complex Transport Systems. This is a platform for adding in real-time transport feeds including tubes, trains and buses, giving us an evolving view of the city in terms of 'commuter flow'. Finally, we combine sources of archive and real-time data on other services and utilities to display alternative views of the city.

Richard Milton joined CASA in 2005 and is a Senior Research Associate currently working on the ESRC funded TALISMAN project, having previously worked on GeoVUE and GENESIS. He is the key developer on these projects, being responsible for the e-infrastructure developed in GENESIS and GeoVUE, which is currently used for real-time web-based geospatial data visualisation. This infrastructure is currently used in the MapTube, SurveyMapper and Gemma websites. Other software includes the GMapCreator for creating, publishing and sharing maps on the web and the Image Cutter for publishing large images. www.maptube.org

Steven Gray joined CASA in September 2009 and is currently working as part of the NeISS project which aims to provide a platform to meet the demand for powerful simulation tools by social scientists, public and private sector policymakers. His current research interests include Human Computer Interaction, mobile development, accessible web development with a focus on Social Media, Web based Mapping and Ubiquitous Computing. www.bigdatatoolkit.org Capturing the Past The panorama was capt front of the Chambermail stencil by the artist Banks of the Roundhouse in Camo According to the Camden M Journal Article the maid is a hotel in Los Angeles.

Tales

Scan Tag

vodafone

Add your tale

Endowing the city with memories

08

The Internet of Things is connecting millions of everyday objects to the Internet. We explore the potential of the Internet of Things to create Smart Places and Hyper-Local-Social hubs throughout the city. We extend the concept to the economic fabric of the city via retail applications such as the Oxfam Shelflife system (custom-created by CASA) and by opening up the potential of a Facebook of Things via the Tales of Things and electronic Memory (TOTeM) project.

> Dr Ralph Barthel joined CASA in 2009 as Research Associate in the Tales of Things and electronic Memory (TOTeM) project and works as design researcher and lead web developer. Prior to joining CASA he did PhD research at the Learning Sciences Research Institute, University of Nottingham. He has many years of industry experience in the learning technology industry as chief technology officer and member of the board of a SMF.

Dr Andrew Hudson-Smith is Director, Head of Department and Deputy Chair of the Centre for Advanced Spatial Analysis (CASA), Editor-in-Chief of Future Internet Journal, an elected Fellow of the Royal Society of Arts and Course Founder and Director of the MRes in Advanced Spatial Analysis and Visualisation at University College London. With a research focus on location based digital technologies he has been at the forefront of web 2.0 technologies for communication, outreach and developing a unique contribution to knowledge. He is author of the Digital Urban Blog and is an investigator on 9 active research grants. His contribution to knowledge and outreach in the fields of digital geography, urban planning and the built environment have been wide ranging with an impact strategy focused on policy, outreach and the public understanding of science. www.digitalurban.org

Dr Martin de Jode joined CASA as a Research Associate in September 2009 to work on the Tales of Things and Electronic Memory (TOTEM) project and is investigating the tagging of everyday objects using 2D barcodes and RFID tags. He developed the Tales of Things iPhone and Android apps which are available from the respective App Stores. Martin's research work involves making the Internet of Things accessible to the general public, through tagging technologies such as QR codes and RFID tags. His research interests include Ubiquitous Computing and Augmented Reality. www.talesofthings.com

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About

OP CityDashboard: your city in real-time

The increasing availability of data on many dimensions of urban activity make it possible to take the 'pulse' of cities in real-time. The CityDashboard project visualizes live information on social networking, transport and geographical trends for major UK cities, providing users with a new perspective on emerging events in their area, and on the rhythms of urban life.

Dr Duncan Smith has been at CASA since 2006 when he came to undertake an ESRC funded studentship into built-environment research using GIS. The thesis was completed in 2011, and is titled Polycentricity and Sustainable Urban Form, analysing built-environment structure and transport energy use in the London region. Amongst CASA's range of research projects, Duncan has focused on urban modelling applications, particularly the ARCADIA project, investigating climate change adaptation in London. He has also worked with the Greater London Authority on providing spatial modelling support for planning analysis. www.geographics.blogs.casa.ucl.ac.uk

Oliver O'Brien joined UCL in 2008 as a researcher/programmer, having previously been a financial software developer, and has worked with spatial interaction models for school-to-university flows, online choropleth maps for census datasets, creation of web mapping tools and city data visualisations. His research interests include open-source GIS, neogeography, cartography and information visualisation. He co-authors the Mapping London blog with Dr James Cheshire and also contributes to the OpenStreetMap project. oliverobrien.co.uk and mappinglondon.co.uk

UDE STATUS (TFL) Bakerloo Central Circle Circle Circle Circle Circle

Central	Good Service
Circle	Good Service
District	Good Service
H&C	Good Service
Jubilee	Good Service
Metropolitan	Minor Delays (more)
Northern	Good Service
Piccadilly	Good Service
Victoria	Good Service
W&C	Good Service
Overground	Good Service

TWITTER TRENDS FOR LONDON

Judith Tebbutt #CMS2012 Mohamm

TWITTER: LONDON NEWS & EVENTS

Londonist: Boris and Ken: who's the most cultu DaveHill: RT @BrockleyCentral: New campaign Evening Standard: Cage-fighting bus driver wh Evening Standard: Somali pirates release Britis Evening Standard: Alcohol abuse is costing Lo

TRAFFIC CAMERAS (TFL)



LATEST OPENSTREETMAP LOCAL UP

Added laban centre City of London photo survey - Edited buildings, POIs, misc changes New supermarket Minor amends in Crofton Park area - local knowledge Adding new



#SometimesItSeemsLi

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DATES





Bearers charged to own 201 actress's 'arm found' Butche insured Johnson to create over tunnel collapse Twins control London Book Fair: R Yeovil

> HAPPINESS (MAPPINE Slightly unhappier

than the whole country right now

Panel Session

Michael Batty Chairman, CASA, UCL

Carlo Ratti Director, Senseable City Lab, MIT

Andrew Hudson-Smith Director, CASA, UCL

Alan Wilson Professor of Urban and Regional Systems, CASA, UCL

Chaired by James Cheshire

Lecturer in Advanced Spatial Analysis & Visualisation, CASA, UCL

This session is being recorded for CASA's Global Lab Podcast www.bartlett.ucl.ac.uk/casa/latest/podcasts and will be presented by

Steven Grav

Research Associate, CASA, UCL

Exhibition

The idea of the smart city involves how we are able to use real time sensing and online data to understand and manage how the city functions, primarily in terms of routine movements such as travel but also in the provision of online services and the use of social media to enable us to better figure out how cities work.

We will show several exhibits that reflect the state of the art about how we represent, interact, simulate, and predict urban futures. These will complement the talks that we will present during the day, providing a sample of what is now possible using new ICT.



Image below: London's road and river networks [Contains Ordnance Survey data © Crown copyright and database right 2012].



The London Data Table

Showing real time feeds of airplane activity over London, the public 'Boris Bikes' scheme, public transport flows over the 24 hour day in the UK, flows on the public transport networks from Oyster Card data, air pollution activity, and other flow data.

Interactive Agent Based Modelling

Showing how riots respond to policing, and how crowds respond to small spaces and obstacles in the local environment.

Pigeon Sim

Fly throughs of London in Google Earth under user control picking up information from real time sensors such as pollution, tidal, and traffic monitors.

Augmented Reality

Using hand held devices imposing augmented realities and virtual worlds showing Twitter feeds, retail activity, and procedural growth.

The Internet of Things

Using RFID technologies to access representations and simulations of traffic flows and scheduling

Animations of Models and Data

Showing simulations of long term land use change, tube movements, shortest network routes, and urban dynamics

Visualisations of New Spatial Data and Models

A potpourri of visualisations from many CASA projects showing new kinds of representations and simulations in maps and related abstractions

Various related media will be on show including different desktop and hand held devices which feature urban media using Tweet-o-Meter and Xbox simulations.



Further information

If you enjoyed the conference and would like to know more about CASA, please visit our website at:

www.casa.ucl.ac.uk

To access blogs by CASA researchers, please visit www.bartlett.ucl.ac.uk/casa/latest/blogs



Other websites you may want to visit: www.digitalurban.org www.maptube.org www.surveymapper.com www.simulacra.info www.mappiness.org.uk www.talesofthings.com www.mappinglondon.co.uk www.casa.ucl.ac.uk/tom www.complexcity.info shelflife.oxfam.org.uk www.spatialcomplexity.info www.maptube.org



MRes in Advanced Spatial Analysis and Visualisation

The MRes ASAV provides training in the principles and skills of social and spatial research. Its aims include a strong understanding of qualitative and quantitative research methodology and methods of data collection and analysis to support and enable independent and group research projects. In addition to focusing on research skills, subject specific modules provide students with the opportunity to develop an excellence in spatial analysis with the specific skill set to engage and contribute to the current debates in urban and spatial continuums.

Our MRes is available either full-time (one year) or part-time (between 2 and 5 years). As the MRes focuses on self-directed study, class contact time is restricted to a minimum number of days for student convenience. Full-time students engage in classes two days per week, and part-time students one day per week, making it a viable option for those with either full-time or part-time employment.

The full-time fees for 2012/13 are set at £5,750 for UK/EU students and £16,500 for international students. Part-time study is charged on a pro-rata basis according to the credit weighting of the modules enrolled in during each academic year.

The 6 MRes modules are:

- GI Systems & Science (led by James Cheshire) [15 credits]
- Knowledge Power (led by Alan Wilson) [15 credits]
- Spatial Modelling and Simulation (led by Michael Batty and Alan Wilson) [15 credits]
- Communication Skills (led by Cliff Elwell and Martin Zaltz Austwick) [15 credits]
- Digital Visualisation (led by Andrew Hudson-Smith and Martin Zaltz Austwick) [30 credits]
- MRes Dissertation [90 credits]

If you are interested in joining the MRes in September or would like further details on any aspect of the course, please contact our Course Co-ordinator, Martin Zaltz Austwick: m.austwick@ucl.ac.uk

> Image: Panoramic sphere of Chicago

