



Sustainable
Infrastructure Systems

UNIVERSITY OF
Southampton

Fourth Annual CDT-SIS Conference



14th November 2018

The Hartley Suite, University of Southampton

EPSRC

Engineering and Physical Sciences
Research Council

Contact us



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You can also live tweet during the conference **@CDTCONFERENCE**

Centre for Doctoral Training in Sustainable Infrastructure Systems

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Welcome to “Creating A Sustainable World” 2018

Welcome to the 2018 Centre for Doctoral Training in Sustainable Infrastructure Systems student run conference. The CDT plays an important role in enabling and carrying out world class research in collaboration with industry, in the strategically vital area of transport, water and energy. The increasing relevance of the CDT to industry, the environment and society is amply and ably demonstrated by the range and significance of the projects outlined herein.

Our Doctoral Training Centre is funded by a £5M grant from the Engineering and Physical Sciences Research Council (EPSRC), together with contributions from a wide range of industry partners. I am delighted to have this opportunity to thank our sponsors and congratulate our students and their supervisors on the breadth, excitement and impact of their work, summarised in this conference.



A handwritten signature in black ink that reads "William Powrie". The signature is written in a cursive, flowing style.

William Powrie FEng, Principal Investigator Centre for Doctoral Training in Sustainable Infrastructure Systems, Faculty of Engineering and Physical Sciences

CDT in Sustainable Infrastructure Systems/ EngD in Transport & The Environment

Welcome to the annual cohort conference for the EPSRC funded Centre for Doctoral Training in Sustainable Infrastructure Systems (CDT-SIS) held in collaboration with the Engineering Doctorate (EngD) programme in Transport and the Environment (EngD in T&E).



The CDT-SIS focuses on the 3 key infrastructure sectors of *Water*, *Energy* and *Transport* with the view to training future leaders in engineering and science needed to develop the national and global infrastructure systems that are essential for economic growth, security, societal wellbeing and environmental sustainability. The EPSRC Centre is developing a new way of thinking amongst engineers and scientists capable of leading the transformation of the national infrastructure from our current sectorized, carbon intensive inheritance to the integrated, low carbon, digitally enabled systems that will be the hallmark of successful economies in the 21st century.

The University of Southampton provides an ideal base because of the strength and breadth of its engineering and applied science expertise, and its excellent links to industry and academia across the globe. CDT-SIS and the EngD in T&E align in their shared ethos of developing and applying the fundamental science and engineering research needed to address the key problems facing society today, within the context of social responsibility and environmental sustainability.

The success of the CDT and EngD programmes depends first and foremost on the hard work and application of the cohort of students. However, it would not be possible without the support of the industrial partners, a pool of supervisory academics, and the administrative team based within the Graduate School of the Faculty of Engineering and Environment. I would especially like to thank Lee Chisman, our CDT-SIS administrator, for all his unstinting hard work.

A handwritten signature in black ink, which appears to read 'Paul Kemp'.

Professor Paul Kemp,

Director, Centre for Doctoral Training in Sustainable Infrastructure Systems

City Map, Conference Venue & Getting Here

Car

- Postcode for satnav: SO17 1BJ
- Visitor parking: Pay and Display car park for visitors can be accessed from University Road. Please note it can fill up very quickly in the morning
- From the M3: Exit at junction 14 (Southampton A33)
- From the M27: Exit at junction 5 (Southampton Airport)

Rail

Fast trains from London and Bournemouth/Weymouth stop at Southampton Central and Southampton Airport Parkway. Trains from Portsmouth and Bristol/South Wales stop at Southampton Central. There are also regular trains from major airports such as Gatwick and Heathrow to Southampton Central. You can find details of routes and timetables on the National Rail website.

Highfield Campus is three miles from Southampton Central, and two miles from Southampton Airport Parkway. You can get the Unilink bus: U1 from either of these stations to Highfield Campus.

Coach

National Express provides regular coach services to Southampton from central London, Heathrow, Birmingham, Bournemouth and the north. Southampton Coach Station is at Western Esplanade, in the city centre. Some coach services also stop at Highfield Campus. From Southampton Coach Station you will need to walk to the nearby Civic Centre, where can continue your journey to Highfield Campus using our own Unilink bus U1 or taxi. The Unilink bus fare is £2 for a single or £3.50 for an all-day pass. Taxi fares from the city centre are usually £6-10.

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August 2016@Cartographic Services, Geography & Environment, University of Southampton

Official Programme

Time	Speaker	Topic
09:00 – 9:20		Registration & coffee
9:20 – 9:40	Professor William Powrie	Opening remarks
9:40 - 10:00	Professor Robert Nicholls	Global estimates of protection costs for coastal defence against sea-level rise
10:00 – 10:20	Professor Abu' Bakr Bahaj	Pathways to universal electricity access for rural communities in Africa
10:20 – 10:40		Coffee break
10:40 – 11:00	Dr Jen Muggleton	Zero Leakage 2050
11:00 – 11:20	Dr Thomas Mbuya	Using plastic waste and quarry spoil to make construction materials
11:20 – 11:40	Dr Angelos Evangelou	Using plastic waste and quarry spoil to make construction materials
11:40- 12:00	Professor Ian Williams	Struvite precipitation within wastewater treatment: A problem or circular economy opportunity?
12:00 – 13:00		Lunch Break
13:00- 13:20	Dr Marcel Suri	Solar GIS – Solar monitoring, solar data and solar assessment
13:20-13:40	Dr Malcolm Hudson	Microplastics
13:40-14:00	Mr Matt Short	Inspiring the next generation of scientists and engineers
14:00-14:20	Prof Hugh Lewis	Space sustainability/ Sustainability of space-based infrastructure
14:20 – 14:40		Coffee Break
14:40-15:00	Dr Ivan Haigh	Detecting sea level acceleration to support the Environment Agency's Thames Estuary 2100 project plans
15:00-15:20	Ms Oleksandra Pedchechno	Improving the way we harvest the heat beneath our feet
15:20-15:40	Professor John Preston	Can strategic modelling help deliver sustainable transport infrastructure
15:40-16:00		Coffee Break
16:00-16:30	Professor Paul Kemp	Closing Remarks and end

Speakers

Presenter Professor Robert Nicholls

Topic: Global estimates of protection costs for coastal defence against sea-level rise

Background: Professor Robert Nicholls is Professor of Coastal Engineering within Engineering and Physical Sciences at the University of Southampton. Robert leads research and education in coastal engineering at the University of Southampton, including collaborating with colleagues in Oceanography, geography and Social Science. His research is focussed on long-term coastal engineering and management, especially the issues of coastal impacts and adaptation to climate change, with an emphasis on sea-level rise. This work occurs at all scales from local research in the Solent, up to global assessments. A major recent theme of research is the future of densely populated deltaic areas which are highly threatened in coming decades. He has also been involved in a number of international assessments, and in particular the Intergovernmental Panel on Climate Change (IPCC), who were awarded the Nobel Peace Prize in 2007. He was awarded the Roger Revelle Medal by the Intergovernmental Oceanographic Commission in 2008. This recognises 'outstanding contributions to the ocean sciences by inspired researchers who communicate their knowledge and global vision of the challenges facing our Planet in order to shape a better future for humankind'. Currently, he co-leads the World Climate Research Programme Grand Challenge on 'Regional sea-level change and coastal impacts' who organised 'Sea Level 2017' at Columbia University in July 2017. He is also a member of the ASCE COPRI Coastal Engineering Research Council.



Presenter Professor Abu' Bakr Bahaj

Topic: Pathways to universal electricity access for rural communities in Africa

Background: Professor AbuBakr Bahaj (FICE, FIET, FRSA, MInstP, CPhys) is a Professor of Sustainable Energy at the University of Southampton. Professor AbuBakr Bahaj leads the 55-strong Energy and Climate Change Division and the Sustainable Energy Research Group at the University of Southampton, where he completed his PhD, progressing from a researcher to a Personal Chair in Sustainable Energy. For more than 25 years, Professor Bahaj has pioneered



sustainable energy research and established the energy theme within the University. His major research programmes can be found at www.energy.soton.ac.uk. These include Cities, Energy and Infrastructure, Data and Modelling, Energy and Behaviour, Energy and Buildings, Energy for Development, Environmental Impacts, Microgeneration Technologies and Renewable Energy (Solar Photovoltaics, Offshore Wind and Marine Energy). Professor Bahaj's work has resulted in over 300 articles, published in academic refereed journals and conference series of international standing. He founded the International Journal of Marine Energy (IJOME) for which he is the Editor-in-Chief. Prof Bahaj also holds visiting professorships at the Xi'an University of Architecture and Technology (XUAT), Xi'an, China, (2017 -), the Ångström Laboratory and Engineering University of Uppsala, Sweden (2011-15) and the King Salaman ben Abdulaziz Visiting Chair for Energy Research, at King Abdulaziz University (KAU), Jeddah, Saudi Arabia (2014 -). He is a Fellow of the Institution of Civil Engineers (FICE), Institution of Engineering Technologies (FIET) and the Royal Academy of Arts (FRSA).

Presenter Dr Jen Muggleton

Topic: Zero Leakage 2050

Background: Dr Jen Muggleton is Principal Research Fellow within Engineering and the Environment at the University of Southampton. Jen Muggleton is a Principal Research Fellow in the Dynamics Group within the Institute of Sound and Vibration Research (ISVR) in the Faculty of Engineering and the Environment. Her main research interests are wave propagation in pipes and in the ground, particularly relating to leak detection and the detection of buried objects. She currently leads the vibroacoustics work in the internationally renowned Mapping the Underworld programme. Jen graduated from Imperial College, London in 1985 with a first class honours degree in Aeronautical Engineering. She subsequently registered for a PhD at the ISVR, whilst being employed at the Admiralty Research Establishment at Portland, Dorset. During her time at Portland she worked mainly on sound propagation and radiation problems concerned with submerged structures. In 1992 she completed her PhD entitled 'Acoustic power flow in fluid filled tubes and cavities'. In 1994 she returned to Southampton as a Research Fellow in the Mechanical Engineering Department, and spent the next four years working on the biomechanics of the human spine, along with image processing and analysis of fluoroscopic images of the human spine in motion. This resulted in the development of the OSMIA system for back pain. In 1999 Dr Muggleton was appointed as a Research Fellow in the Dynamics Groups within ISVR where the main focus of her work has been on wave propagation in pipes, initially relating to water leak detection and, more recently, to buried pipe location and detection. In 2004 she instigated the vibroacoustic element of Mapping the Underworld in which she has been extensively involved ever since. In addition, she has undertaken research



on automotive tyre vibration as well as on a number of other smaller structural dynamics projects. In 2007 she was promoted to Principal Research Fellow.

Presenter Dr Thomas Mbuya

Topic: Using plastic waste and quarry spoil to make construction materials

Background: Dr Thomas Mbuya finished his PhD in 2012 and was in the Engineering Materials group. He was supervised by Prof Philippa Reed and Prof Ian Sinclair. He is now a Senior Lecturer in the Department of Mechanical and Manufacturing Engineering at the University of Nairobi.



Presenter Dr Angelos Evangelou

Topic: Using plastic waste and quarry spoil to make construction materials

Background: Dr Angelos Evangelou did his PhD here at the University of Southampton. His thesis was titled 'Fatigue-oxidation interactions in single crystal NI-based Superalloys'. He graduated in 2017 and was in the Materials Science group or Engineering Materials group. He is now a research fellow at the University.



Presenter Professor Ian Williams

Topic: Struvite precipitation within wastewater treatment: A problem or circular economy opportunity?

Background: Ian Williams is a Professor of Applied Environmental Science and Associate Dean (Enterprise) in the Faculty of Engineering and the Environment at the University of Southampton, UK. He has an established track record in the field of environmental pollution and waste management. His work at Southampton has focused on pollution, waste- and carbon-related issues. Ian has published extensively in books and peer-reviewed journals as well as producing over 100 commercial project reports. He has a long track record of holding positions as an External Examiner for taught and research degrees, service on external bodies, sitting on the scientific and organizing committees of several international conferences, working on national and international task groups. Ian has received multiple awards for his research and educational activities. Ian obtained his first degree in Chemistry from the University of Surrey in 1988 and a PhD in Public Attitudes to Air Pollution from Road Traffic from Middlesex University in 1995. He has been a lecturer at Middlesex University (1989-2000), the University of Central Lancashire (UCLan, 2000-2004) and the University of Southampton (UoS, 2005-present). He was the founder and Head of the Centre for Waste Management at the UCLan. He has appeared numerous times on broadcast media, including on BBC Radio 4's Costing the Earth.



Presenter: Dr Marcel Suri

Topic: Solar GIS – Solar monitoring, solar data and solar assessment

Background: Marcel Suri is an expert in solar power assessment and forecasting. He has received PhD in geography. Marcel Suri consults developers and operators of solar power plants, investors, banks, and governmental institutions. He is active in grid-integration studies related to solar photovoltaics. He is managing director of Solargis Company, which provides solar and meteorological data and photovoltaic simulation software for planning, monitoring and forecasting of solar power.



Presenter Dr Malcolm Hudson

Topic: Microplastics

Background: Dr Malcolm D Hudson is Associate Professor in Environmental Sciences at University of Southampton. Malcolm is an applied ecologist working on interdisciplinary projects with a focus on the interactions between humans and natural systems. This spans both terrestrial and marine systems, working with ecologists, environmental modellers, chemists and social scientists. His PhD was in Environmental Sciences at Southampton investigating the effects of invasive species on coastal ecosystems.



His lecturing includes environmental impact assessment and environmental practice and issues; Malcolm supervises student projects at all levels, assisting field courses and practical modules, and works as an Undergraduate Programme Co-ordinator, having previously overseen undergraduate admissions.

Malcolm has been either PI or co-Investigator in research grants worth over £3.5million, including the joint Research Councils/DfID ESPA Programme, DEFRA, English Nature (now Natural England), SITA Trust, ABPmer, Marwell Wildlife, the People's Trust for Endangered Species, OilSpill Response, the British Ecological Society and Beaulieu Estate; and supervised twelve PhD students to completion with six others currently active.

He advises local government on Biodiversity Action Planning and ecosystem services and has worked with industry in the same field. He is External Examiner University of Portsmouth (Countryside and Wildlife Management Programmes); He is also a regular reviewer for Journal of Environmental Management, Environmental Impact Assessment Review, Landscape and Urban Planning.

Presenter: Mr Matt Short

Topic: Inspiring the next generation of scientists and engineers

Background: Matt Short is currently doing his PhD part time with Paul Kemp and is in the ICER research group in Water and Environmental Engineering. He is looking at the effects of acoustic stimuli on fish schooling behaviour. He also works for the Southern Universities Network <https://www.sunoutreach.org/about/>



Presenter Professor Hugh Lewis

Topic: Space sustainability/ Sustainability of space-based infrastructure

Background: Dr Hugh G Lewis is Senior Lecturer within Engineering and the Environment at the University of Southampton.

He gained a Master's degree in Control Systems from the University of Sheffield in 1993 and a PhD in Remote Sensing from the University of Southampton in 1998. Afterwards, he worked as a research assistant on the EU Framework 4 project FLIERS (Fuzzy Land Information from Environmental Remote Sensing), based in Electronics and Computer Science, before commencing a three-year contract at the end of 1999 as a researcher on an EPSRC funded project on the long-term evolution of the space debris environment. This work led to a decade-long working relationship with Dr Graham Swinerd, the development of the DAMAGE space debris model, my work for the UK Space Agency, numerous publications and an inspiring (and also challenging) journey into the realm of space debris and Near Earth Objects. For the last six years he has represented the UK Space Agency (previously the British National Space Centre) in Working Group 2 of the Inter-Agency Space Debris Coordination Committee (IADC) and he now leads the Group's research on space debris modelling. In 2011 he was nominated as the United Kingdom's representative to the United Nations Committee on the Peaceful Uses of Outer Space (COPUOS) Scientific and Technical Subcommittee (STSC) Expert Group B (Space Debris, Space Operations and Tools to Support Collaborative Space Situational Awareness), supporting the activities of the UN COPUOS STSC Working Group on the Long-term Sustainability of Outer Space Activities.



Presenter: Dr Ivan Haigh

Topic: Detecting sea level acceleration to support the Environment Agency's Thames Estuary 2100 project plans

Background: Dr Ivan D Haigh is Associate Professor in Coastal Oceanography within Ocean and Earth Science, National Oceanography Centre Southampton at the University of Southampton.

Ivan Haigh is Associate Professor in coastal oceanography at the University of Southampton. Ivan's main research interests are:



Assessing historic and determining future changes in mean and extreme sea levels at local, regional and global scales; and

Determining how to effectively translate global projections of absolute sea level rise down to regional and local scales in practical terms that will aid coastal managers and engineers inform flood and erosion risk-based management and for future planning.

In this regard, he is interested in all aspects of sea level variations from time scales of minutes (ocean surface waves), hours (seiches, tides), days (storm surges), through to longer term changes (seasonal, inter-annual and longer-term changes in mean sea levels, lunar tidal cycles). He has experience in assessing observational datasets (i.e. tide gauge records, wave buoy data) and tide/surge and wave numerical modelling for short (forecasting, navigation) and long (coupling with climate models to assess past/present and potential future changes in storm surges, extreme sea levels and coastal flooding) term applications.

Ivan is currently the Principal Investigator/Co-Investigator of two major research projects. He leads the NERC-funded iGlass consortium project (2011-2015) which is using interglacials to assess future sea-level scenarios. Ivan leads the Southampton component of the EPSRC-funded Flood MEMORY consortium project, led by Newcastle University. The overall project aim is to investigate the effects of temporal clustering of flood events on natural built and socio-economic systems with memory, in order to identify critical vulnerabilities, better allocate resources for protection and recovery and improve flood resilience. Ivan also is actively involved in several projects with DHI, UNESCO-IHE, the Australian Department of Climate Change and the New South Wales Office of Environment and Heritage.

In regards to teaching, he is the co-director (together with Robert Nicholls) and admissions officer of the MSc Engineering in the Coastal Environment. This programme is uniquely provided jointly by academics from the Faculty of Engineering and Physical Sciences, based at Highfield Campus and Ocean and Earth Science, based at the National Oceanography Centre. The programme is strongly linked to industry and focussed on applied issues in the coastal zone.

The overall goal is to educate technically-orientated coastal practitioners for suitable employment in coastal engineering, both in consultancies and relevant areas of government

Presenter: Oleksandra Pedchenko

Topic: Improving the way we harvest the heat beneath our feet

Background: Oleksandra Pedchenko is a Postgraduate research student in coupled fields of shallow geothermal energy and hydrogeology within Engineering and the Environment at the University of Southampton. am a third year PhD student in fields of shallow geothermal energy and hydrogeology within the Faculty of Engineering and the Environment at the University of Southampton.



Her research interests are Hydrogeological modelling, modelling to optimise for sustainable thermal performance of shallow geothermal energy applications and comprehensive management of groundwater resources (used as aquifers and aestifers)

Current research project: Modelling the long-term thermal performance of shallow geothermal energy applications in different hydrogeological environments. This project contributes to the EU funded project for the European cooperation for shallow Geothermal Energy Applications in Buildings and Infrastructures (TUD COST, Action TU1405 / GABI).

Her completed Master's project: Conceptual versus physically-based approach to modelling leachate flow and solute transport from a municipal solid waste landfill: Dual-permeability linear storage mixing model versus MACRO 5.2 (Joyce Lambert Prize 2015)

Presenter: Professor John Preston

Topic: Can strategic modelling help deliver sustainable transport infrastructure

Background: Prof. John Preston is Professor of Rail Transport within Engineering and Physical Sciences at the University of Southampton.

Professor John Preston is also the Head of the Transportation Research Group. He was previously Head of the Civil, Maritime and Environmental Engineering and Science Academic Unit (2011-2014), Director of the Transportation Research Group (2008-11) and Head of the School of Civil Engineering and the Environment (2010-11). He has over 30 years of experience in transport teaching and research, having previously held posts at the Universities of Leeds and Oxford. His research in transport covers demand and capacity modelling, regulatory studies,



economic appraisal and land-use and environment interactions. His initial work concentrated on rail but subsequent work has covered all the major modes of transport. He has held over 130 research grants and contracts, worth over £10 million, and has published over 300 articles, book chapters, conference and working papers.

His current work at Southampton includes leadership of the DITTO consortium, that is undertaking research to optimise rail operations, and of the University's contribution to the Centre for Sustainable Travel Choices. He is also providing transport expertise to the Track to the Future and MISTRAL projects. He previously led the iConnect consortium that undertook an evaluation of engineering interventions to promote walking and cycling, and contributed to the Track21 and Infrastructure Transitions Research Consortium Programme Grants.

Poster Presentations

1. Olusegun Adesina – *“Zero Leakage 2050: Leak Noise Characterisation for Buried Pipelines”*
2. Keiran Ball – *“Tribo-Corrosion of Marine Systems”*
3. Antonello Climan
4. Will Crawford-Jones – *“Fundamental Insights into Sediment Transport”*
5. Jack Daniels – *“Investigating novel uses of electricity in freshwater ecosystems”*
6. Lewis Dolman – *“Exploring the relationship between river restoration, ecology and flood risk management”*
7. Amelia Holgate – *“Developing behavioural deterrents for power stations”*
8. Rahma Nassoro – *“Hydrant Dynamics for Leak Detection”*
9. Sam Reeve – *“NITRO Microwave Neutralizer for X-EPT Ion Thruster”*
10. David Stanley – *“3D Mapping of Geometrically Complex Seafloor Infrastructures using Marine Vehicles”*
11. Christopher Tacon – *“Porous Micro-Electrospray Propulsion System for CubeSats”*
12. Ndubuisi Uchendu – *“Combining Transient and Steady State Methods for Acoustic Leak Detection”*
13. Abhinav Aggarwal
14. MJuh Achsani Takwim Mahendro
15. Boniface Hima
16. Hameed Jehanfo
17. Jack Callaghan
18. Barry Smith
19. Maria Ramos Suarez

Student Chairs

Registration – Mr Toby Roberts, Environment and Transport

Morning Session – Mr Hameed Jehanfo, Transportation Group

Midday Session – Ms Freya Radford, Environmental Sciences

Afternoon Session – Mr Chris Tacon, Astronautics Group

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