URBAN FLOWS OBSERVATORY

#SensorBuild: Final Pitch Event

Schedule for the evening

17:30 - 18:00 Arrival, networking, drinks
18:00 - 18:10 Welcome from Dr Danielle Densley Tingley & intro to judging panel
18:10 - 18:30 Guest speaker keynote: Rick Robinson, Digital Property & Cities Leader, Arup
18:30 - 19:00 Novice pitching
19:00 - 19:30 Break for pizza and beer
19:30 - 20:10 Advanced pitching
20:10 - 20:20 Break for beers and for the panel to convene
20:20 - 20:30 Awards including the popular vote

Social Media

@UrbanFlowsObs
#SensorBuild

Popular Vote

Go to: www.slido.com
Enter the event code: SensorBuild

Pitching order - Novice

1	Upstanding Urban Energy & Resources flow using Ubiquitous Monitoring	Lu Bai
2	Ask the Bees	Simon Cookson and Martin Smith
3	On-node public realm analysis	Joachim Dreimann, Gary Martin, and Drew McLaughlin
4	DUST (Duren Urban Flows Sensors Team)	Bernardi Pranggono, Sapto Wibowo and Perry Ismangil

Pitching order - Advanced

5	Chain Home	Timothy Butterfield
6	IoT Multi-use sensor technology (I-MUST)	Yun-Hang Cho and Gianni Heung
7	Track-side Environment Monitoring Station	Ruby Kempka, Mike Watson, Thomas Butcher
8	Low Cost Distributed Air Quality Monitoring Over Mobile Networks	Alex Petersen
9	Electronic Acoustic Recognition Sensor (EARS)	Stuart Walker

If you want to contact any of the competition entrants and don't get a chance to speak with them this evening, email urbanflows@sheffield.ac.uk and we'll connect you.

Keynote Speaker

Rick Robinson - Digital Property and Cities Leader, Arup

Rick leads Arup's Digital Property and Cities business, advising cities, infrastructure operators, developers and investors on the use of technology to increase value, performance, and user experience. Rick regularly collaborates with a network of technology entrepreneurs, universities and social institutions to explore how digital innovation can be scaled to create smart places and cities that improve the everyday lives of citizens.

Rick is a Fellow of the British Computer Society and the RSA, and a member of the Academy of Urbanism, Board of Innovation Birmingham, and Birmingham Science City Alliance. He also founded and chair the Birmingham Smart City Alliance, and advised the UK Government and United Nations on their impact on infrastructure, communities and society. Prior to joining Arup, Rick was the Director of Technology for Amey, driving digital technology into public services and infrastructure that are used by approximately 25% of the UK population. He was also the Executive Architect for Smarter Cities at IBM.

Judging Panel

Professor Daniel Coca - Head of Department
Automatic Control & Systems Engineering, University of Sheffield

Viewing modern cities as systems-of-systems, Daniel is interested in developing a framework for integrating, analysing and modelling in real-time the data generated by large heterogeneous arrays of sensors across multiple spatial and temporal scales, to help understand the emergent properties of cities, to characterise their performance – especially city resilience and robustness – and to provide a quantitative basis for designing urban policies and forecasting their impact through exploratory simulation analyses and optimization.

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Ogo Osammor - Lead Air Quality Officer
Air Quality, Monitoring & Modelling, City Growth Department

Ogo is currently the lead officer in developing Sheffield's Air Quality Action Plan (AQAP) and leads on Air Quality and Land Use Planning issues. He also works with the Urban Flows Observatory on understanding the use of low cost sensors in air quality monitoring. Ogo has several years' experience in air quality management and was involved in the preparation of the 1st edition of the NSCA guidance on dealing with air quality concerns. He has worked with the Centre of excellence for low carbon and fuel cell technologies (Cenex) to develop the "Low Emissions Strategies Development Programme".

Mark Gannon - Director, Business Change & Information Solutions
Sheffield City Council

Mark Gannon is a Director at Sheffield City Council. He is responsible for the Council's business change, IT, information management and digital agendas. He chairs the City Region CIO Forum and has a focus on making Sheffield a digitally thriving city.

To help do that, he co-founded 'dotSHF' – Sheffield's Digital Coalition – which is working to connect Sheffield's digital sectors, amplify the good stuff and help fill the gaps. Mark represents the Council on the Urban Flows Advisory Board.

David Moss - Digital Programme Manager
Siemens Research

David Moss is Digital Programme Manager for Siemens Research in the UK. David works with the UK's research base, enabling partnerships between industry, academia and applied research facilities, to drive digital innovation in Industry. He joined Siemens in September 2017 following careers at IBM and the Government's Science and Technology Facilities Council where he led the IoT programme and was responsible for commercializing advanced research technologies for the benefit of society and business.

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1 Upstanding Urban Energy & Resources flow using Ubiquitous Monitoring

Dr Lu Bai received the B.Eng. degree in Biomedical Engineering from Tianjin University, Tianjin, P.R. China, in 2009, and the Ph.D. degree in Electronic Engineering from the University of Kent, Canterbury, U.K., in 2014. Dr Lu Bai is currently working as a KTP associate with Shearwater System Ltd and University of Kent. During June 2016 – April 2018, she was working as a Research Associate in Department of Computer Science at University of Sheffield.

Her main research interests are Internet of Things, mobile sensing, machine learning in healthcare, and 3-D human upper limb motion tracking for rehabilitation purpose. She has authored and co-authored publications in high impact IEEE journals and international conferences.

A sensing system is developed to sense the air quality, weather condition and human well-being related data (human activity and mobility) by using low cost IoT sensing platforms. This type of sensor uses low cost architectures (e.g. Raspberry Pi and Arduino). Sensors is planned to be mounted on the bicycles and monitor the air quality in a green way. All the collected sensor data is fed back to a web server for data storage and further analysis. These data can be used by the urban scientist to model the energy and resources flow in and out of the city.

2 Ask the Bees

Presenting this evening are **Simon Cookson and Martin Smith** on behalf of Hive IT. Hive IT's mission is to use the right tools & technology to make positive changes to the world we live in. Founded back in 2014 by three friends with the drive to do something different, Hive IT's mission is to use the right tools and technology to make positive changes to the world we live in. We build great teams that get the job done. This means being open, honest and really caring about each other and the quality of what we do. Our day jobs are all about software, digital platforms and designing for users, so we are relative newcomers to the world of sensors and IOT.

We'd like to build a sensor that gathers data on the health, activity and conditions within beehives, and the atmospheric conditions around them. This data can be used to monitor the health and productivity of the colony as well as warn beekeepers of events such as swarming, theft and overwintering problems. We'd then like to take the data from the hives and integrate it with the data from the Urban Flows air quality sensors & weather stations.

3 On-node public realm analysis

Joachim Dreimann, Gary Martin, and Drew McLaughlin work together at WANdisco in Sheffield. All three are interested in what the Internet of Things will become, for its effect on society or the technology involved. They started this project with varying degrees of experience in dabbling with the necessary components, but all experienced in the design and delivery of enterprise grade software.

Drew has recently designed and built a solution that automatically monitors and regulates the temperature of his home-brewing equipment for the perfect beer. Gary has extracted a complex set of system statuses into a simple array of status LEDs which make it much faster to see where to focus attention and communicate the overall status more widely. Joe has previously engaged with the Open Data group and to design a Sheffield app. He is now looking at bringing IoT to education.

Our sensor intelligently analyses the public realm to help with efficient resource allocation. It starts by detecting availability of car parking spaces. All processing happens on the device itself for enhanced privacy. The results can then be visualised and provided as open data.

4 DUST (Duren Urban Flows Sensors Team)

We're a group of Indonesian geeks in Sheffield that loves tinkering! The team is **Bernardi Pranggono, Sapto Wibowo and Perry Ismangil.**

We propose urban flows air quality and atmosphere monitoring tools that monitors Ozone (O3), Carbon monoxide (CO), Sulphur dioxide (SO2), Nitrogen oxides (NOx), Volatile organic compounds (VOC) as suggested by DEFRA.

We use Sodaq Explorer equipped with various sensors and LoRaWAN equipment. We use The Things Network (TTN) LoRaWAN gateway to send the data from the sensors. The data collected will be analysed in the Cloud platform.

We propose that the air monitor tools are collecting data via a public transport such as a bus. Using bus, we can collect more data as we have more bus than the special monitor van that is planned to be used. It is also greener and more energy efficient!

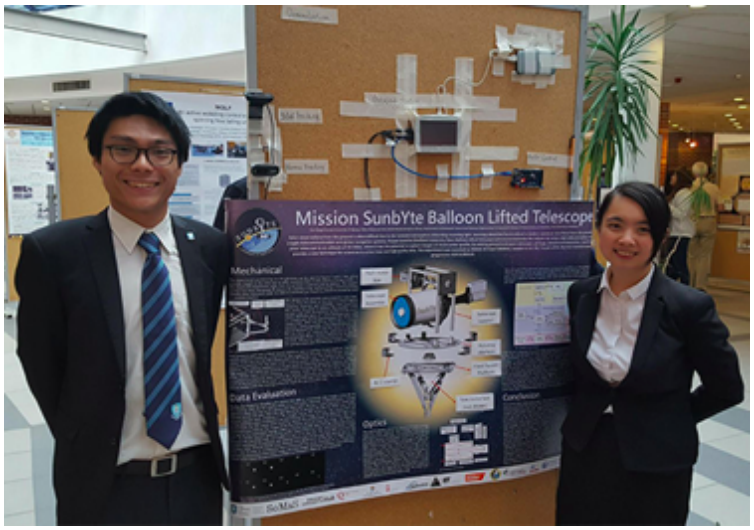
5 Chain Home

Tim Butterfield is a final year MEng Civil Engineering student at the University of Sheffield. During his studies he has worked for Crossrail, Thames Water and BuroHappold Engineering. He brought IABSE's Future of Design conference to Sheffield in April 2017, inspiring student and graduate engineers to propose creative structures with their own architectural merit.

During his MEng thesis project, he has developed a new anchor for the floating wind turbine market, and is intending to find industrial partners with whom to develop this further. He has also enjoyed university music life in the university symphony orchestra, and is actively involved with his local church. Tim is starting a PhD project to develop robotic construction vehicles at the University of Cambridge in October.

Chain Home is a network of 'outpost' units that sample key air pollutant parameters, with dedicated sensors for temperature & humidity, VOCs, dust, carbon monoxide, nitrogen dioxide and ammonia. The data is sent via GSM at 5-minute intervals to the ThingSpeak cloud-based system; there the live-updated data can be presented and analysed, and sites across the city compared. The USPs of the concept are its rugged construction, data upload frequency, and 'install & forget' ultra-low maintenance requirements.

6 IoT Multi-use sensor technology (I-MUST)



The two developers, **Yun-Hang Cho and Gianni Heung** hold first class bachelor degrees in Mechanical Engineering and Electronics Engineering respectively. Both have experience in designing systems for monitoring and tracking weather phenomena.

Mr Cho is a PhD researcher conducting experiments into remote sensing of water flows at the University of Sheffield's Civil Engineering department. Data collected is being used to build CFD models in conjunction with international research organisations to prevent flooding and better manage our waterways.

Miss Heung is the lead Electronics Engineer who is working on a near Space mission to send a solar telescope into the upper atmosphere on board a NASA high altitude balloon and remotely monitor the Sun from a low density environment with low light pollution and air distortion effects. Combined they have programming skills in C, C++ and Python, certified CAD experience and the rapid prototyping knowledge necessary in this type of project.

In 2008, the UK set the climate change act with air pollution targets. Being able to remotely detect the humidity and air pressure variation of the urban environment as it changes throughout the season will help not only predict pollutant transportation but also on rainfall. Coupled with knowledge of the local waterways, this could provide advanced warning for flash floods.

The author presents the low cost I-MUST sensor platform (Internet of Things Multi-Use Sensor Technology) which delivers a holistic approach to air quality and weather monitoring by providing real time data on air pollutants, temperature, wind direction and speed, rainfall, humidity and air pressure. Combined with the latest advances in “Internet of Things”, researchers and engineers can easily perform remote access via telecommunication networks through VPN to monitor the devices and receive incoming data. Using machine learning, new computational models can be developed to predict distribution of pollutants at the Urban Flows observatory. The device is easy to install and is a powerful mini weather station with incredible commercial value as well as research potential.

7 Track-side Environment Monitoring Station

The team is formed of three researchers from the University of Sheffield railway research department.

Ruby Kempka: I am a third year PhD student studying the effect of environmental conditions on the formation and properties of iron oxides / rusts on the railhead. I enjoy life drawing and beer.

Mike Watson: I am a postdoctoral research associate looking at the causes of friction and how it can be predicted in extreme interactions. I enjoy rock climbing, fell running, landscape photography and paragliding.

Thomas Butcher: I am in the 1st year of my PhD looking into leaf chemistry and bonding mechanisms on rail track. I am passionate about Engineering, especially practical implications of research and the environment.

An environmental monitoring device has been developed to monitor trackside conditions relating to the health and mechanical performance of rail infrastructure. High time resolution monitoring, low cost and long battery life are achieved with the devices allowing for a multi-station solution to be rapidly and cost-effectively deployed. In addition to the main station, a portable novel spectroscopic device to identify and quantify the presence of small amount of the moisture on the railhead has been designed.

8 Low Cost Distributed Air Quality Monitoring Over Mobile Networks

My name is **Alexander Petersen**, an enthusiastic hobbyist maker coming towards the end of my PhD studentship. Not only did this seem like a fun project to work on and an opportunity to develop some skills, I do feel that air quality is one of the biggest issues that we face as a society.

'Big data', despite the slightly obnoxious moniker, is clearly going to form an important part of the future, and getting grassroots involvement early on is very promising – something I'm certainly keen for.

This project seeks to lower the barrier to entry and thereby expand the scope of air quality monitoring by significantly reducing the cost of a single station. This cost saving is principally achieved through the use of low-cost, uncalibrated sensors that, while not of enormous utility in isolation, can enable exploration of trends over wide areas with high resolution. Supplementing this data with a small number of high-cost, conventional air quality stations will further enhance insight. Low maintenance is also key, with the unit only needing a power connection, and being rated to IP44 for indoor or outdoor use. Communication is performed over conventional cellular networks ensuring high coverage and reliable infrastructure without user intervention.

9 Electronic Acoustic Recognition Sensor (EARS)

The EARS system was designed by **Stuart Walker.** Stuart has always loved making, unmaking, repairing and designing things, from kit cars to electric scooters, wind turbines to remote control dustbins, and recently all sorts of monitoring and sensing machinery.

Away from work (at the University of Sheffield) Stuart likes to run, eat, and tries to persuade people to pick up litter through a small charity called Runners against Rubbish.

Every person, object or creature has a unique acoustic signature. Using a network of simple, cheap and low power remote sensors and a central classifier, the EARS system records these signatures to monitor flows at key points throughout the city.
Low Cost: Under £200, allowing a network to be deployed
Responsive: Built-in WiFi for real-time monitoring
Intelligent: Semi-supervised classification system learns with every signature
Adaptable: Able to monitor anything from traffic to bird and animal life
Robust: Locked IP65 housings with no external components