Smart Infrastructure Workshop

Geoff Merrett
01 November 2019
WORKSHOP OBJECTIVES

Objectives

1. Identify pockets of relevant expertise
2. Stimulate discussion
3. Identify opportunities for new collaborations, particularly across ‘physical and digital worlds’
# AGENDA

### Session 1 - School of Engineering

<table>
<thead>
<tr>
<th>Time</th>
<th>Topic</th>
<th>Presenter</th>
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<tbody>
<tr>
<td>13:30</td>
<td>Welcome</td>
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<tr>
<td>13:50</td>
<td>Towards Self Monitoring Auto-reporting Railway Track</td>
<td>Prof William Powrie</td>
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<tr>
<td>14:00</td>
<td>Condition monitoring of earthworks</td>
<td>Dr Joel Smethurst</td>
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<td>14:10</td>
<td>Drones: from avoiding the infrastructure to being part of it</td>
<td>Dr András Sóbester</td>
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<td>14:20</td>
<td>Big Data in Aeroengines</td>
<td>Prof Honor Powrie</td>
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<td>14:30</td>
<td>Real-time monitoring of chemicals in water environment</td>
<td>Dr Xize Niu</td>
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<td>14:40</td>
<td>Smart Buildings</td>
<td>Prof Patrick James</td>
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<tr>
<td>14:50</td>
<td>Discussions, Brainstorming and Refreshments</td>
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### Session 2 - Electronics and Computer Science

<table>
<thead>
<tr>
<th>Time</th>
<th>Topic</th>
<th>Presenter</th>
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<tbody>
<tr>
<td>15:20</td>
<td>Smart Grid</td>
<td>Dr Thomas Andritsch</td>
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<tr>
<td>15:30</td>
<td>On-chip monitoring to detect cyber-security threats</td>
<td>Prof Mark Zwolinski</td>
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<td>15:40</td>
<td>Using internet standards for IoT in infrastructure</td>
<td>Prof Kirk Martinez</td>
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<td>15:50</td>
<td>Crowdsourcing air-quality monitoring</td>
<td>Dr Seb Stein</td>
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<td>16:00</td>
<td>Smart energy analytics</td>
<td>Prof Gopal Ramchurn</td>
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<td>16:10</td>
<td>Closing Remarks</td>
<td>Prof Geoff Merrett</td>
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<td>16:15</td>
<td>End of Event</td>
<td></td>
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WORKSHOP OBJECTIVES

Speaker Brief

• Cover relevant:
  1. Track record
  2. Future interests, ideas, opportunities, challenges
  3. Expertise beyond themselves (including both those in the room, and those who are not)

• ...and keep to time!
C-IOT STRATEGY

Centre established ~18 months ago

1. Build the IoT Community
2. Improve External Reputation
3. Foster New Collaborations
4. Explore Educational Programmes
5. Support Public Engagement
C-IOT RESEARCH CAPABILITY/AREAS

Sensor Technologies
Research into new and novel sensor devices to enable new innovative applications.

Data Management and Analysis
Accessing and making sense of the wealth of data obtained from the IoT.

Power and Energy
Increasing the lifetime or autonomy of IoT devices through improved management and efficiency and/or self-powered approaches.

Nanotechnology and Transistor Devices
Enabling faster, cheaper and/or lower-power computation.

Security, Safety and Privacy
Enabling a secure and trusted IoT, from hardware through to software.

Communications and Networking
5G communication and efficient networking to support future systems.

Information Processing and Machine Intelligence
Processing data and inferring information.
SENSOR TECH. + TRANSISTOR DEVICES
Capabilities + Example Project

• Devices for:
  – Sensing
  – Logic/computation
  – Memory
  – Communication

• Macro/micro/nano scale
• Printed and wearable electronics

Aims of this project
Miniaturise existing sensing technology, use arrayed sensors for augmented sensing close to wear site

To detect early evidence of lubricated contact decay from charge maps of the surface.

• Better prediction of remaining useful life
• Corrective adjustment of running conditions

Below: Southampton Nanofabrication Centre

Nick Harris
CMI
SENSOR TECH. + TRANSISTOR DEVICES

Distributed Air Pollution Monitoring

- Platform: Wearable Tech for Smart Cities
- Low cost pollution monitoring
  - Mobile sensors
    - Wearables?
    - Bicycle mounted?
    - COTS vs custom
  - Processing of noisy/erroneous data

https://airpoll.co.uk/
COMMUNICATIONS AND NETWORKING

Capabilities

• 5G comms and Massive Machine Type Communication (mMTC)

• Interests include:
  – Coding and modulation
  – Cognitive radio
  – MAC protocols
  – Routing strategies
  – 6LowPAN, CoAP, LoRAWAN etc
  – …
SECURITY, SAFETY AND PRIVACY

Capabilities

• Cyber Security Academy and ACE

• Example IoT Research Areas:
  – Hardware root of trust/PUFs
  – Network security
  – Anomalous behavior detection
  – IoT device fingerprinting
  – Decentralised transactive energy

DECENTRALISED TRANSACTIVE ENERGY

• Motivation
  – Renewable energy sources are increasing but their energy generation is volatile, hence hard to integrate with the traditional energy system
  – Prosumers could trade energy autonomously with other prosumers/consumers without interacting with central energy suppliers

• Approach
  – Decentralised infrastructure to enable peer-to-peer energy trading
  – Based on blockchain and smart contract technologies, strong integrity guarantees on energy transactions and energy trading application logic
SECURITY, SAFETY AND PRIVACY

Example Project: Trustworthy Mission Planning for Autonomous Systems

• Fleet of UAVs, USVs, UUVs performing tasks, e.g.
  – Survey (e.g., lawnmower pattern),
  – Orbit (within radius of a point)
• While USVs/UUVs survey, UAVs collaborate to provide situational awareness
• Mission scheduling optimises time within constraints, e.g. avoiding restricted areas
• Validation and verification to ensure that the plan satisfies the constraints

• Current project with Thales UK and School of Engineering, UoS
POWER AND ENERGY

Capabilities

• Self-powered systems
  – A battery in every one of the billion IoT devices?
  – Energy/power harvesting
  – Battery-free and energy-driven systems

• Energy-efficient IoT (end-devices > edge > data centre)
  – ULP operation
  – Efficient networking
  – Energy-management
POWER AND ENERGY
Example Projects: Self-Powered Condition Monitoring

• Powered from engine vibration
• Vibration data wirelessly communicated
FIND OUT MORE

• Keep an eye on our website
  www.c-iot.ecs.soton.ac.uk

• Register an interest to find out about:
  – Future events
  – Opportunities for collaboration (targeted)
  www.c-iot.ecs.soton.ac.uk/find-out-more
YOUR QUESTIONS

Professor Geoff Merrett, Head of Centre

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