

Microwave sensing of turbulent flow processes for intelligent drainage monitoring and management

Stream

The Industrial Doctorate Centre for the Water Sector

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Sewer problems

- The UK wastewater pipes are deteriorating
- Cause sever **flooding incidents**
- Important to gather information to enable efficient pro-active management



Traditional technologies



- CCTV, laser profiling and zoom camera
- Relatively good resolution
- **Slow** and relatively **expensive**

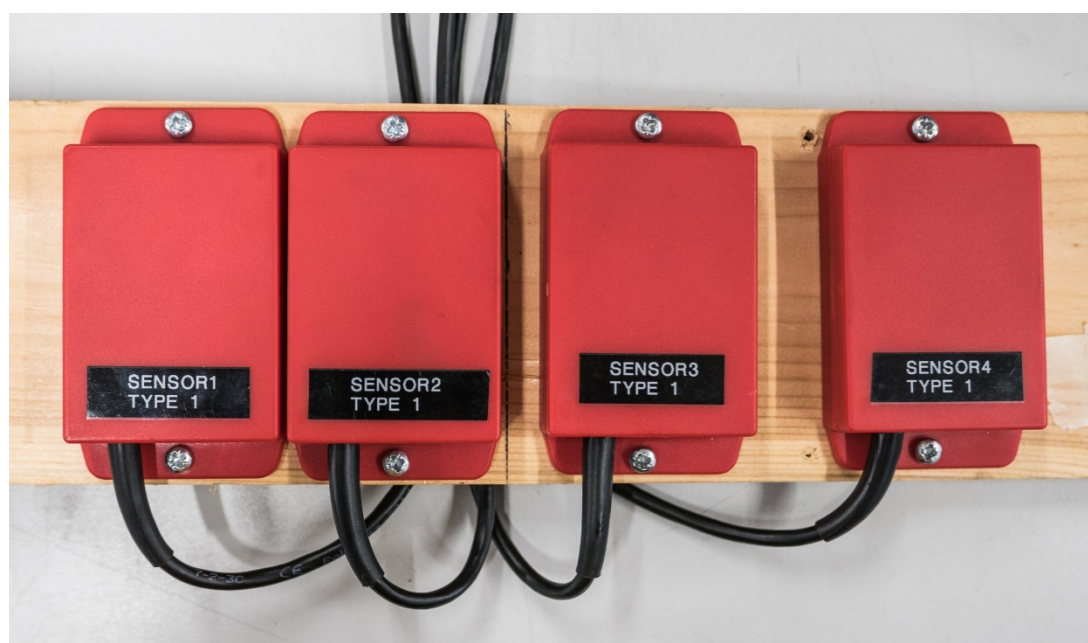
Remotely measuring free surface 'fingerprint'

- More recently, **non-contact** measurement devices have become increasingly popular.
- Flowing water exhibits a **unique** surface pattern driven by the flow induced turbulence.
- This pattern appears to be a function of the underlying flow properties. [1]
- Examination limited only in detail for flows in rectangular channels.



Aim: To develop a microwave sensing technique, which can enable the widespread and non-intrusive monitoring and management of drainage infrastructure.

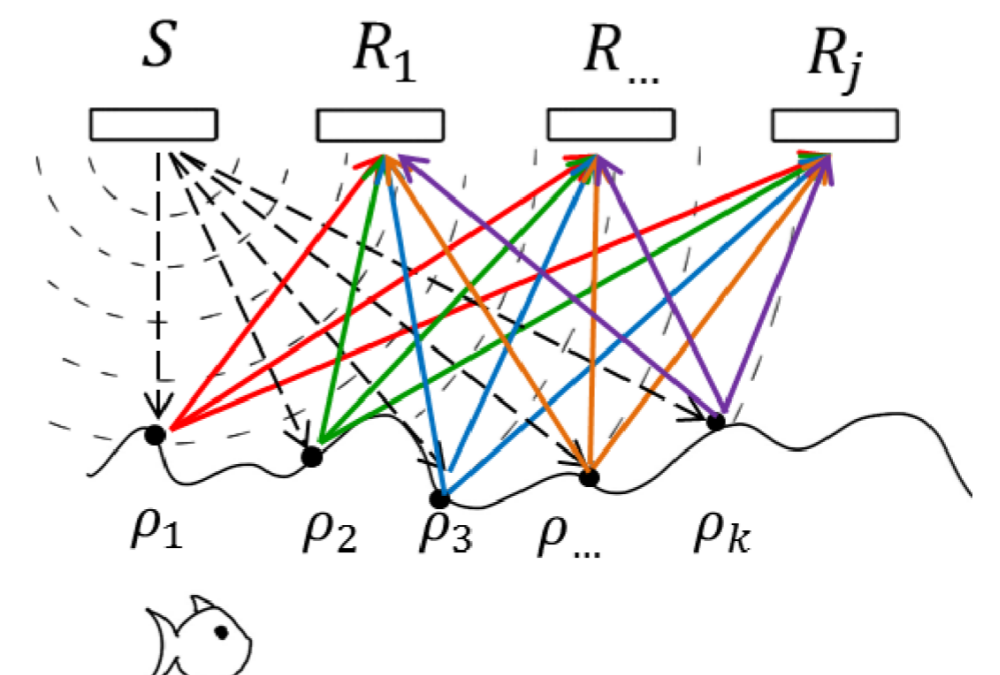
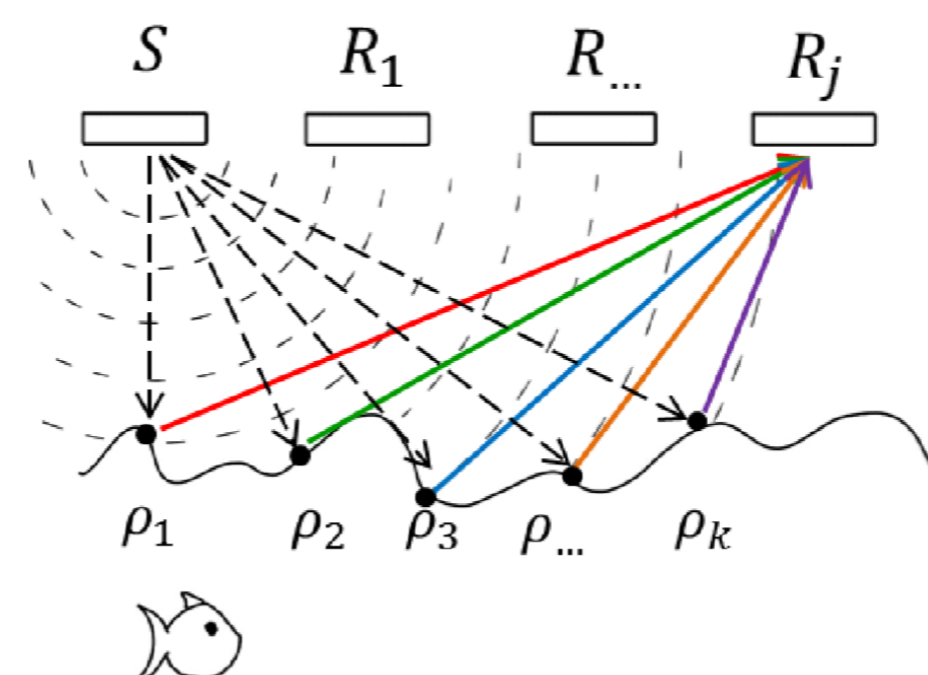
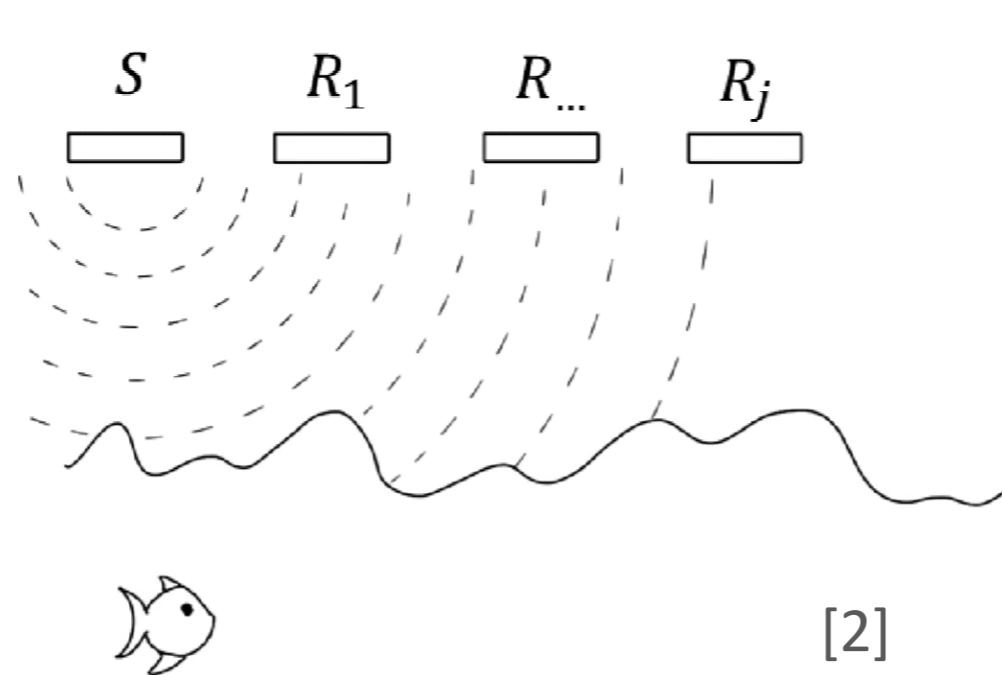
Hydraulic measurement using microwave sensors



- Dynamic Flow Technologies microwave sensors
- University of Sheffield unique circular pipe
- Necessary hydraulic examinations
- Reconstruct instantaneous free surface pattern from sensor data
- Use reconstructed surface to infer flow conditions



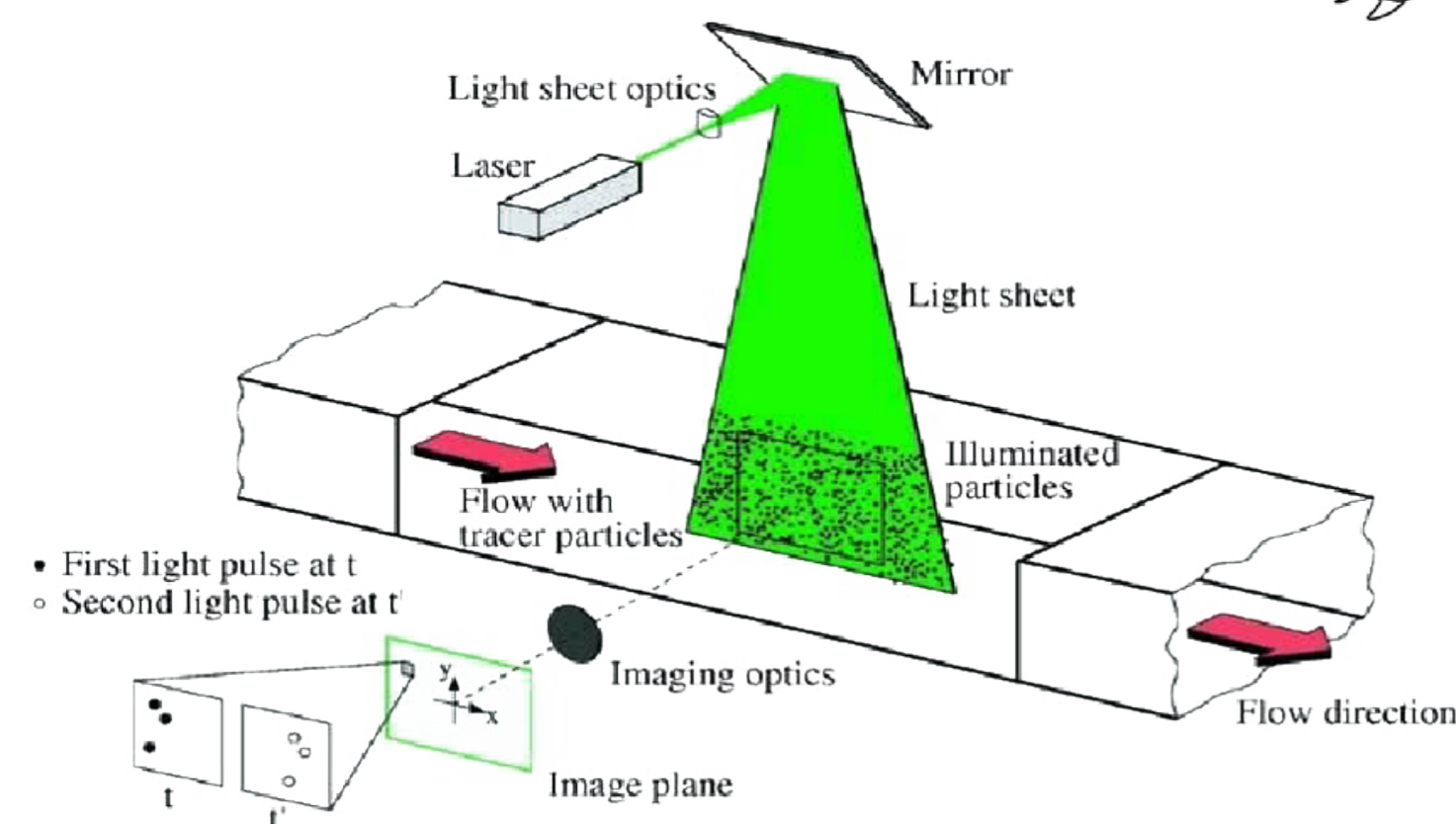
- A microwave source S
- Reflection of microwave by the water surface
- Multiple Receivers R_i



Future plan

After characterise the microwave sensors, extensive laboratory tests will be conducted to measure synchronously

- **Microwave transducer array data**
- Particle image velocimetry (PIV): Sub-surface velocity field
- Laser-induced fluorescence (LIF): Free-surface fluctuation



[1] Nichols, A. Free surface dynamics in shallow turbulent flows. (2013). PhD thesis, University of Bradford

[2] Dolcetti, G. Reconstruction of the rough water surface profile with an acoustic imaging technique. (2018). DRG showcase, University of Sheffield

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