

transformati•n

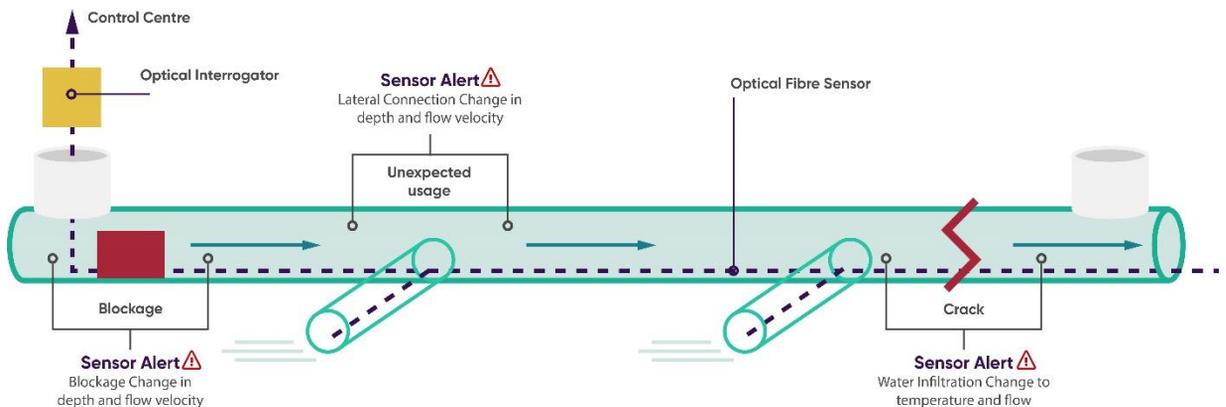
make infrastructure make sense

nuron fibre sensing technology is not 'spot' but 'continuous' in-pipe sewer monitoring with in-built networking capabilities to transform wastewater infrastructure and build smart cities of the future.

Unique Functionality

1. **Measurement of** flow depth, velocity and temperature at ALL locations and ALL times along a section of sewer,
2. **Spatial resolution of 5m** over a length of at least 10km,
3. **Smooth ragging-free** containment system compatible with existing sewer operations,
4. **Less than 1% space occupancy** in sewer pipes,
5. **Robotic installation** giving retrofit access even to small diameter pipes,
6. **Additional networking fibre** to address branched networks and deliver networking capability.

How It Works



nuron Solution Components

1. Optical Fibre Sensors (Measuring)

nuron uses distributed fibre optic sensors to deliver a high density and frequency of flow measurement. These optical fibres form the 'nerves' of nuron, both sensing their environment and transmitting data in real time.

2. Sensory Containment System (Measuring)

The nuron containment system has extremely low space occupancy; less than 1% in a 300mm pipe. It acts like a 'skin' combining the robust protection required for optical fibre sensors in the harsh environment found in sewers and drains, with the sensitivity needed to measure fluid flow conditions.

3. Optical Interrogator (Monitoring)

All active components and data processing reside at the surface within an optical interrogator, the 'brain' of nuron, running bespoke algorithms for translating turbulent flow and depth data into management information.

4. Control Centre (Management)

A state of the art graphical user interface and app reporting tool presents incident alerts and management information to any computer or remote device for decision making.

End to End Solution

Management

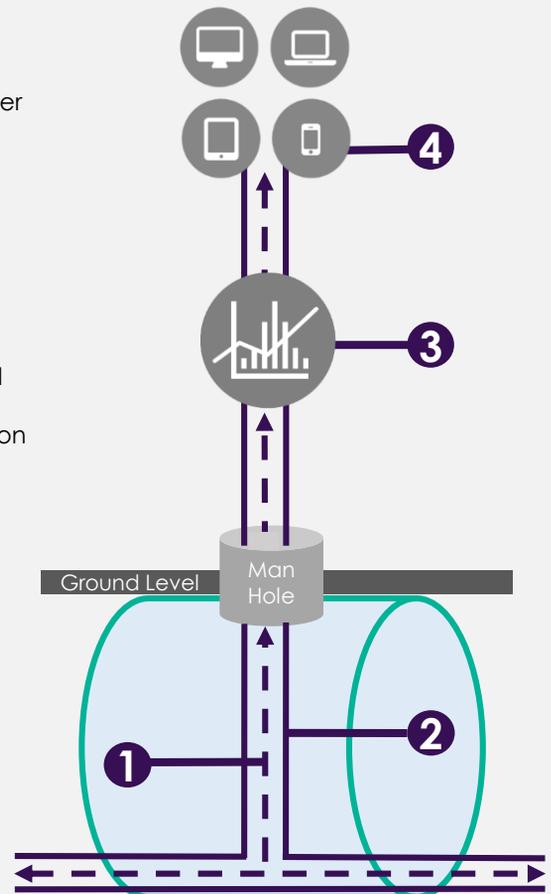
Smart control of active infrastructure is facilitated by a rich data source supplied over a resilient fibre network to an Optical Interrogator and Control Centre, increasing effective system capacity and avoiding capital expenditure.

Monitoring

Solids build-up and sewer collapses are detected in real time, preventing blockages and targeting interventions to give improved resilience. Temperature and flow measurements detect ground water infiltration and guide remediation works.

Measuring

Continuous 'in-pipe' measuring of multiple flow parameters.



soluti•n

make nuron make sense

nuron fibre sensing technology has several areas of novelty which make it a unique and beneficial solution for the global wastewater industry.

Functional Benefits



Flow Monitoring and System Maintenance

- **Real-time detection of blockage formation** using changes in flow depth and velocity.
- **Targeted cleaning and maintenance** through detection of solids build up.
- **Early detection of blockages** reducing risk of sewer flooding and associated fines.
- **Monitoring of SUDS installations** (Sustainable Urban Drainage Schemes) directly or indirectly.
- **Model validation & improvement** using dense data capture including diurnal and seasonal variations.



Integrity and Security

- **Detection of infiltration** as influx of cold water away from lateral, possibly correlated with rainfall.
- **Real-time detection of burst water pipes** as influx of cold water not associated with rainfall events.
- **Real-time alerts on sewer collapse** through changes in flow velocity and acoustic properties of the pipe.
- **Detection of crack propagation** through repeated crack acoustic signatures at a location.
- **Detection of void formation** around sewers prior to formation of sink holes through changes in acoustics.
- **System security monitoring** by detection of manhole ingress and nearby works.
- **Detection of unauthorised material dumping** through monitoring sudden changes to flow rate or chamber access.



Active Control

- **Facilitation of active control** through real-time monitoring of flow rates at many hundreds of locations.
- **Avoidance of capex** through increased effective system capacity using active monitoring and control.
- **Safe in-system storage** of flood water with real-time monitoring to avoid overflows.
- **Intelligent control of CSOs** with evidence for strategies to reduce total discharge.
- **Dense data input to machine learning** control algorithms used for system optimisation.



Commercial and Reputational

- **Improved reputation** through engagement with innovation and improved environmental record.
- **Detection of mis-connections** to foul sewer.
- **Analysis of discharge volumes** from commercial / industrial users, potentially leading to network metering.
- **Network metering** of domestic users via flow rate detection at each inflow point.
- **Improved customer engagement** through sharing of intuitive and rich network data.
- **Temperature monitoring** for integration with heat recovery schemes.

collaborati·n

make science make sense

nuron wastewater and sewer experts have worked together to develop and patent a next generation, dual-purpose fibre sensing technology for wastewater operators and industry.

Technical Advisors

nuron's entrepreneurial management team are complimented by a team of technical advisors for Optical Fibre Sensing and Networking, Sewer Engineering and Fluid Dynamics from the Pennine Water Group (a leading urban water engineering research group in the UK) at the University of Sheffield.



Prof. Kirill Horoshenkov
MEng, PhD, MEng, PhD
Professor of Acoustics

Kirill Horoshenkov is Professor of Acoustics in the Department of Mechanical Engineering at the University of Sheffield. He is an expert on novel sensing technologies for the inspection of underground assets and instrumentation.



Don Ridgers
Bsc (Eng)
Former Engineer for Thames Water

Don Ridgers was formerly Principal Engineer for Wastewater Network at Thames Water, the UK's largest Water and Sewerage Company, specialising in sewer rehabilitation, asset deterioration, asset failure research and integrating the established benefits or solutions through continual improvement of company standards and into investment plans.



Prof. Simon Tait
Bsc (Eng), PhD
Professor of Water Engineering

Simon Tait is Professor of Water Engineering in the Department of Civil and Structural Engineering at Sheffield University. He is an expert in the processes associated with sedimentation in river and urban drainage systems and the hydrodynamics associated with flows over rough, water worked sediment deposits.



Dr. Stuart Kingsley
CEng, MIET, SMIEEE
Former Chief Scientist for SRICO

Dr. Stuart Kingsley developed fibre-optic phase modulation concepts for communication and sensing systems in the 1970's and was the first to show optical fibres could be used for sensing. The former Chief Scientist for SRICO in the USA with a focus on Fibre Optic and Integrated-Optic Communications and Sensing, now runs a photonics consultancy.