Pipebots

Water Industry Challenges Workshop Overview

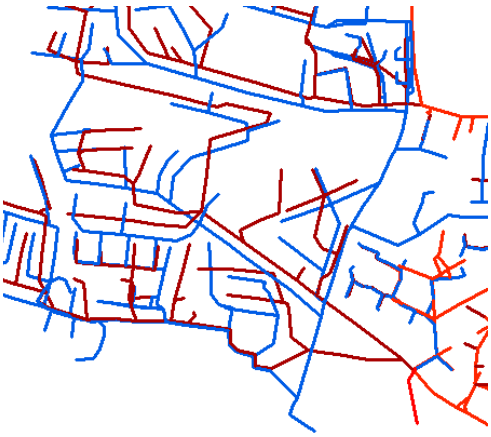
The Pipebots Water Industry workshop on 12th July 2019 aimed to (i) identify the key buried infrastructure inspection challenges that the UK water industry faces and (ii) disseminate information to build understanding of the scientific and technical challenges for pervasive sensing in buried pipes.

The workshop comprised three sessions: firstly to identify and rank the inspection challenges, taking into account impacts and future scenarios; secondly three short presentations on the current technical capabilities and challenges for robotic pipe inspection systems; and finally to draft plans to deliver practical implementation of autonomous robotic inspection systems to deliver the highly ranked challenges from the first session.

This overview summarises the six key challenges, their impacts and potential delivery pathways resulting from the workshop.

Asset Mapping

Asset databases for buried pipe networks are regularly incomplete, both in terms of network coverage and specific details, such as material and diameter. Pipes near to properties are especially uncertain, with connectivity errors common in drainage networks. This is due to the age of the network, changes in ownership over time, changes in database technology (e.g. from paper records to computer), and repairs and replacement of the original pipes.



The challenge has two key parts: firstly to gather accurate location data for the buried pipes and related assets; and secondly to provide or check key information on those assets, i.e. pipe diameter and pipe material.

Poor asset data mainly impacts on the water utility, but has knock-on effects to the public through, for example, increased traffic disruption when locating assets. The challenge was ranked highly in all scenarios.

The workshop delegates suggested that by 2020 test areas could be identified so that by 2025 a robotic solution could be demonstrated for small areas, collecting data remotely and travelling up to 2 kilometres. It was thought that robotic swarms focused on asset mapping could be achieved by 2030.

Leakage

Leakage from piped water distribution networks is a key (and enduring) challenge. While water utilities are able to locate larger leaks the process is time consuming. Locating smaller leaks, especially in plastic pipes, remains challenging. The main challenge for Pipebots is to detect and locate leaks with reasonable precision (1 m was suggested) and to do this in a timely manner.

Leakage is regularly a focus for the regulator and media coverage results in negative public perception. In times of water scarcity leakage presents a serious risk to supply. Population growth and climate change increase pressure on water resources, thus meaning leakage remains important in most future scenarios.

it was noted that in-pipe technologies exist that can “detect leaks under ideal conditions”, it was suggested that in the short term robots could deploy these technologies more widely. In the medium to long term, sensing technologies can be developed that can identify pre-cursors to leaks and include more complex hydraulic measurements.

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Condition Monitoring

The condition of buried pipes is very difficult to assess, but understanding the condition accurately is important to maintain or improve service performance and extend the life of assets at an affordable cost.

This is a broad challenge due to the many potential failure modes between water distribution and drainage, different pipe materials, different ground conditions, etc.

Better understanding condition directly impacts the water utility, but using this knowledge to improve system performance will improve conditions for the public and the environment. Condition monitoring was viewed as important in all future scenarios.

The delegates identified cross-overs with asset management in the short term through sensing asset type and material. In the medium term coarser condition assessment or performance related measures such as leak detection could be applied. In the long term high resolution condition assessment would be developed to support the development of reliable deterioration models.

Cost-Benefit

The regulation of the water industry drives the need to manage networks at the "lowest" cost whilst providing "acceptable" levels of service and environmental impact. Cost-benefit is not a specific task for robots, but one to be achieved through the design and implementation of the robots, whereby the benefits of using robotic technologies can be shown to outweigh costs.

This challenge impacts directly on the water utilities in terms of profitability and the customer in terms of bills. It also impacts all stakeholders if system performance is improved.

It was suggested that in the short term robots could locate and classify problems in a small area to prove benefits. Long term delivery of pervasive sensing could be truly disruptive.

Impact on the environment

All piped networks can have an impact on the environment, but this is highest from wastewater networks which contain pollutants. The type of environmental impact depends on the event and location. Wastewater networks most commonly cause pollution when they are overloaded and spill to watercourses, although extreme overloading or blockage can also result in flooding.

Delegates considered that flooding of properties was the biggest impact issue. Rapid identification of blockage and sewer collapses were considered essential. Given the spatial spread and potential for rapid growth of in-pipe blockages it was considered that robot swarms would be needed, which was considered to be a longer term goal.

No Disruption

This challenge covers two areas: i) disruption to supply of the service; ii) disruption to other activities (e.g. transport). System knowledge gained from robotic inspection would allow a better understanding of condition and performance, allowing maintenance to be better planned and allowing an increase the take up of trenchless technologies.

Staged delivery of autonomous inspection would initially boost a move to proactive management and eventually result in the UK water sector meeting its 2050 aspirations for "no blockages"

The full workshop report, which includes more details on the rationale for the selected challenges, impacts and delivery strategies can be found on the Pipebots website: www.pipebots.ac.uk.

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