News Article for RISUD Strategic Focus Area (SFA) Scheme

		Name	Department
1.	**Principal Investigator**:	Prof. Xiaoli DING	LSGI/PolyU
2.	**Name of SFA:**	Smart Utilities	
3.	**Project Title:**	Development of a Strategic Focus Area (SFA) in Utility System Research	

4. **Third Year Progress/Achievement (***in layman's language, no more than two A4 pages***)**

The project has focused on developing and testing various sensing technologies to detect and monitor conditions of underground utilities systems. These include space borne radar remote sensing technologies, satellite based positioning technologies, in-situ sensors such as distributed fiber optic sensors, and ground based radar technologies such as ground penetrating radars (GPR). The research has enhanced the technologies for monitoring conditions of underground utility systems. New interferometric synthetic aperture radar (InSAR) algorithms have been developed to enhance the capability of the technology for monitoring ground and infrastructure deformation. Time-lapse GPR slices and change detection algorithms have been developed for more accurate subsurface diagnosis. The research has also enabled better understanding of distributed fibre optic sensing technologies in monitoring water pipe conditions. We have developed a 3D convolutional neural network (3D-CNN) based approach to analyze the data from the distributed fiber optic sensors. A series of experimental studies carried out in the laboratories have demonstrated that the approach can accurately detect water leakage. Figure 1 shows the experimental setup of a fiber optic sensor system in a laboratory environment while Figure 2 illustrates the process of system installation of such a sensing system at a test site. Figure 3 shows that leak flow rate as low as 0.03L/s can be detected by utilizing the sensing capability of an optic fiber and the 3D-CNN with a location accuracy of about 3 m. The technology should be suitable for installation on new water pipes, such as those to be installed for the Tomorrow Lantau and Northern Metropolis projects or during rehabilitation of old water pipes.

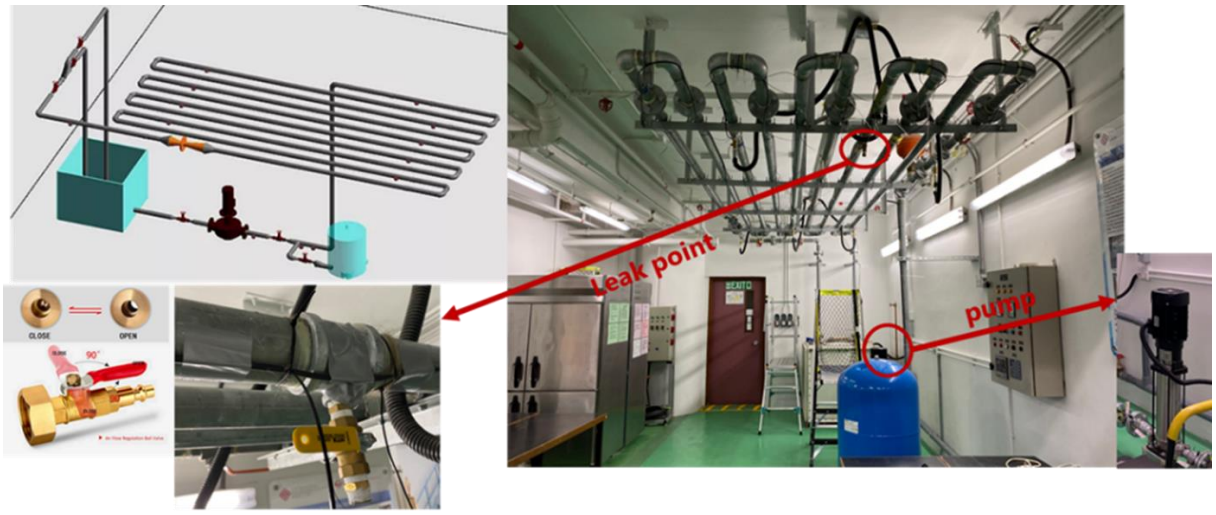
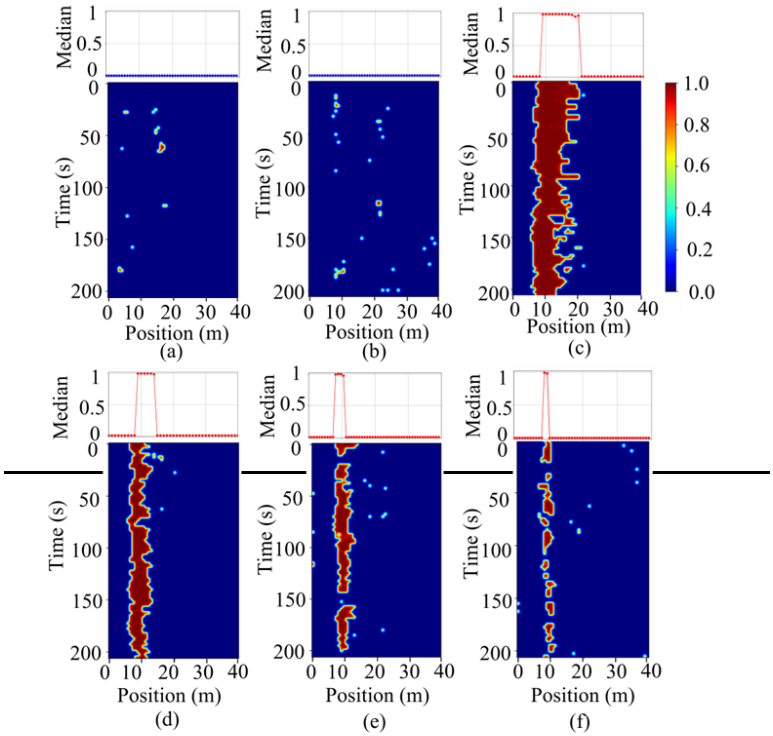


Figure 1: A fiber optic sensor system was used in a laboratory to detect signals of water pipe leakage

Figure 2: A fiber optic sensor system is being installed at a site



(a) no leak with pipe flow of 0.427 L/s, (b) 1.800 L/s,
(c) leak with leak flow over pipe flow ratio of 74.1%,
(d) 23.89%, (e) 11.61%, (f) 1.50%.

Figure 3: Water leakage signals detected by a fiber optic sensor system