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Novel design of a smart guided-wave-based sensor to enhance the ability in detecting defects occurred in pipes

Pipes are important infrastructures in modern cities. Carrying gas, water and sewage wastes, pipes are prone to defects as a result of aging and corrosive environment. Detecting such defects in their early stages is of vital importance so that any gas and water leakage and subsequently disastrous explosions can be avoided. Today, there is no commercially available system that can effectively detect defects occurred in building pipes especially when they are concealed in concrete wall. Guided wave (GW) is a popular NDT method for detecting corrosion occurred in pipes. Here, an innovative GW-based sensor that employed smart materials for emitting desired GW signals into a pipe and then receiving signals reflected from any pipe defects has been designed. Different than conventional piezoelectric transducers, which is time and labour intensive to be mounted on inspected objects, a new magnetostrictive sensor, which is embedded with our invented flexible printed coil and a thin patch of smart material, has been developed. Because the entire sensor is made out of thin sheets, it can be easily wrapped around any size of pipe. By employing smart material, which has stronger magnetostrictive property, the GW energy emitted by the sensor for detecting defects has been significantly enhanced. Moreover, the smart sensor can be applied to both metal and plastic pipes. Several field tests

were conducted in buildings using in-service gas pipes that were partially covered by building walls. The results prove that the smart sensor can reveal pipe defects and corrosion even part of the pipe is covered by walls. Finally, the current market available transduction systems was found to be bulky and expensive. Hence a new, low-cost and portable transduction system has been implemented so that it can be workable on-site and inspects in-service gas pipes that are installed in modern buildings.

Biography

Peter W Tse is a Fellow of American Society of Mechanical Engineers and a Foundation Fellow of International Society of Engineering Asset Management. He is the Associate Director of the Centre for Systems and Informatics Engineering. He obtained his B.Eng. and M.Sc. from Canada and his Ph.D. from United Kingdom. He is a Chartered Engineer and a Professional Engineer registered in UK and Canada. He is the committee member of ISO's Technical Committees (TC): TC108, TC135 and TC199. As of today, his Scopus h-index 34 with 4,980 citations and Google Scholar h-index is 39 with 6,830 citations. He has published over 460 articles in various journals, proceedings, newspapers etc. Currently, his research outcomes have been applied to over 30 local and international companies. Recognized by the Council of Canadian Academies as the author of Top 1% most highly cited papers in the related research field worldwide in year 2016.

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