Quantification of thickness loss in liquid-loaded pipes based on guided wave tomography

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ABSTRACT

Corrosion damage in fluid-filled pipes is a significant problem to the oil and gas industry, reducing the wall thickness and increasing the chance of leakage. Accurate thickness mapping of corrosion damage is critical to assess the integrity and residual life of pipes. Ultrasonic guided wave tomography provides a solution to this. It is carried out by a pair of ring arrays of piezoelectric transducers attached on the pipe, which excite and receive ultrasonic signals propagating inside the pipe wall. In fluid-filled pipes, the attenuation of waves due to fluid loading limits the exploitation of the information contained in higher order helical signals that wrap around the pipe multiple times before reaching the receivers, thus degrading the quality of reconstructions. In this work, the effect of the attenuation on the reconstruction performance is investigated by using full waveform inversion in conjunction with a helical signal separation method and a regularization technique. The experimental results demonstrate that the maximum depth estimation of the defect in water-filled pipe with the attenuation considered in the inversion model matches well with that of the empty pipe.

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