Corrosion detection and localisation utilising a novel thin film guided wave sensor sparse array

Cameron Dick[1], Matthew McInnes[1], Claire Thring[1], Daniel Irving[2], Dave A. Hughes[3]

[1]Product Team, Novosound, United Kingdom, [1]Head of Innovation, Novosound, United Kingdom, [1]CEO, Novosound, United Kingdom

Detecting and pinpointing corrosion-related damage in infrastructure poses significant financial and technical difficulties. Current inspection systems primarily use guided wave technology for long-distance assessment of pipeline integrity. However, these systems struggle to precisely identify and localise defects. On the other hand, high-frequency systems offer better resolution but lack the range of conventional guided wave systems. Our research seeks a middle ground between these two methods by employing machine learning and a scalable setup. We placed a flexible array of printed thin film sensors around two identical mild steel pipes (each 0.5m long with a 6 mm wall thickness). One pipe had artificially induced corrosion. We used two transmit transducers on the top and bottom of the pipes to perturb the pipes using a curated waveform. The transmitted waveform was then received on all sensors throughout the array . Through machine learning and a search algorithm, we achieved sub-millimeter resolution in detecting millimeter-scale corrosion. We could also pinpoint the corrosion location within the sensor array. Crucially, we maintained system scalability for large-scale asset inspection. This technology shows promise in addressing inspection challenges, including Corrosion Under Pipe Supports (CUPS) and Corrosion Under Insulation (CUI). It offers a potential solution to the costly problem of infrastructure damage detection and localisation while retaining scalability and a low-profile design philosophy .