

**Accelerating Level-3 Fitness-For-Service Assessments for Pipeline Metal Loss
Using Machine Learning**

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ABSTRACT

Level-3 Fitness-For-Service (FFS) assessments for metal loss in pipelines, as outlined in API 579, often require complex finite element analysis (FEA) which are computationally expensive and time-consuming. This research introduces a novel approach to accelerate the FFS process by integrating a localized feature extraction method with a machine learning algorithm. The process begins with collecting high-dimensional ultrasonic (UT) thickness data. FEA is performed on this data to generate pass/fail labels. A localized feature extraction technique is then applied to identify regions with low thickness and their spatial distribution, reducing data dimensionality while preserving key features that impact FFS results. The reduced feature set is used to train a machine learning model to predict FFS outcomes. Once trained, the model can perform real-time assessments on new UT scan data, eliminating the need for repeated FEA simulations. This approach significantly reduces the time required for Level-3 FFS assessments, offering substantial gains in computational efficiency and practicality, which consequently reduces the costs associated with these assessments.