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Machine learning techniques for pipelines health monitoring under stationary and non-stationary environments

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Abstract

Artificial intelligence using machine learning techniques has become omnipresent in different field of studies. Structural health monitoring is an emerging field which should take advantage of these techniques in order to be efficient and more reliable. It aims mainly at detecting and localizing damage in structures automatically without the need of the interpretation of data (i.e. human analysis) as it is done in non-destructive techniques. In this work, some cases of study of detection and localization of damage in pipeline during a monitoring period will be presented. Two types of learning environment: stationary and non-stationary will be considered. In the latter, the variation of environmental and operational conditions could have an impact on the reference signals and hence, as these signals are generally compared to the actual signals, this will give rise to false alarm. To deal with this issue, we propose to build a model of reference data whenever a new measured signal is available. In the former, intelligent feature extraction and selection methods are considered to ensure a better damage detectability and to avoid overfitting. In the case of learning in stationary environment, reference data are supposed to be constant. Data is gathered on a tube where an artificial damage was placed on the surface. However, in non-stationary environment, data was collected on pipe segment where temperature fluctuates due to the weather changes. A corrosion-like damage was machined in this case in several steps in order to increase its size. In both cases, damage was detected successfully using the above-mentioned machine learning techniques. Besides, a procedure for damage localization was developed in the second case. Further technical details will be provided in the oral presentation.