Ph.D. in Information Technology
Thesis Defense

April 13th, 2023
at 15:00
Room ”Schiavoni” and online by Teams

Riccardo Angelo Giro – XXXV Cycle

ADAS Smart vibroacoustic monitoring of pipeline fluid transportation assets

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Abstract:

Nowadays, the transportation of hydrocarbons on a large scale and through long distances (up to several thousands of kilometres) is often undertaken by means of pipeline networks, which represent an efficient and widespread tool for the conveyance of oil and gas products. Potential damages or failures to such structures might have severe environmental, health, and economic repercussions: as a result, pipeline monitoring becomes an operation of paramount relevance. The current technologies for overseeing the condition of fluid transportation assets make use of physical measurements collected along the conduits, from which data-driven relations can be derived. Such constitutive relations are subsequently analyzed to predict the future operational status of a given pipeline network. However, there is still uncertainty in the literature on how to systematically build an effective monitoring technology. More specifically, two gaps have been identified: firstly, there is not an established and rigorous methodology for deriving data-driven relations and evaluating the reliability of pipeline integrity techniques; lastly, most solutions are not industry-ready yet, as they lack validation on real pipeline assets or are not enabled to operate in real-time. The latter is essential in the modern oil and gas industry, as fast-paced environments demand quickly adaptive control systems. This work aims at overcoming such limitations: after having established a solid set of clearly repeatable principles, three different pipeline monitoring challenges are presented. For each one, a specific data-driven solution has been developed to solve the related issue and concurrently satisfy all the aforementioned technological requirements. Lastly, all the proposed applications are based solely on single- or multi-point acoustic pressure measurements collected along the conduit, which are typically already available in most pipeline assets: this further simplifies the implementation of such techniques in an industrial scenario.

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