Project Title: Structural Health Monitoring of Pipelines with Use of Vibrations and Artificial Intelligence

Supervisor's Name: Morteza Mohammadzaheri

Co-Supervisor(s): *(if already known)*

Sources of Fund: A grant supplied by Medco Energi Oman

Research Field(s): structural health monitoring, vibrations, artificial intelligence

Summary and Problem Statement:

The proposed research aims at development of an inexpensive vibration-based health inspection method for pipelines. The core idea is that a pipeline is excited at a number of points and the consequent vibration is measured far from the excitation points (an excitation and a measurement point can be a kilometre away or even further). It is well-known that any change in pipeline structure affects vibrational response; however, it is practically impossible for human beings to interpret information of vibrational tests. Preliminary research by the supervisor of this project has shown that artificial intelligence systems could provide accurate information the faults on pipes or even more complex mechanical structures [1-3].

This project is supported by Medco Energi Oman, and a state of the art experimental setup has been already fabricated and is now available and functional at Sultan Qaboos University. The designated student will work alongside with the supervisor and a team of researchers from academia and industry

Keywords: pipelines, structural health monitoring, vibrations, artificial intelligence

Objectives:

The proposed research aims at development of an inexpensive vibration-based health inspection method for pipelines.

Tentative Methods of Approach:

1) Conducting experimental vibrational tests on pipe samples (the test rig is ready)
   A Masters student can pick one of steps 2 or 3, based on his/her preference, a PhD student should work on both
2) Vibration analysis of the pipeline with numerical methods with use of experimental results
3) Use of artificial intelligence to interpret the experimental data

4)	Development of the structural health monitoring systems and working with industry for its industrial use

Required backgrounds and skills
Backgrounds:
Familiarity with pipelines, structural health monitoring, vibrations, data analysis or artificial intelligence will be desirable. However, learning materials (videos and …), guidance and supervision will be available to provide the student with sufficient information and skills during the project.
Computing Skills: MATLAB
Other requirements:

References:

[1] Mohammadzaheri, M., Akbarifar, A., Ghodsi, M., Bahadur, I., Al-Jahwari, F., and Al-Amri, B., 2020, "Health Monitoring of Welded Pipelines with Mechanical Waves and Fuzzy Inference Systems," International Gas Union Research ConferenceMuscat, Oman.

[2] Taajobian, M., Mohammadzaheri, M., Doustmohammadi, M., Amouzadeh, A., and Emadi, M., 2018, "Fault diagnosis of an automobile cylinder head using low frequency vibrational data," Journal of Mechanical Science and Technology, 32(7), pp. 3037-3045.

[3] Akbarifar, A., Mohammadzaheri, M., Joudaki, A., Jamshidi, E., Khabbaz, S., Parmoon, M., and Emadi, M., 2015, "Fault Detection of Gas Pipelines Using Mechanical Waves and Intelligent Techniques," International Conference on Artificial Intelligence, Energy and Manufacturing Engineering Dubai, UAE.