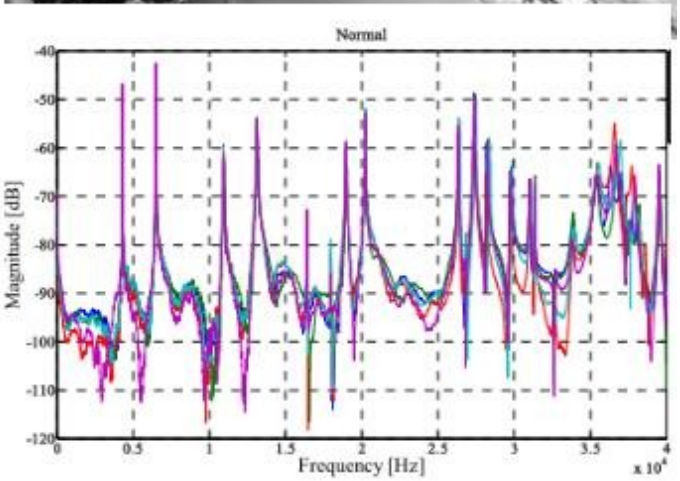
Loose Bolt Identification via Machine Learning of Laser Ablation Vibrational Data

Project Summary: Maintenance of large structures is an extremely costly and often hazardous endeavour which needs to be performed on a regular basis. Among the many inspection tasks which needs to be undertaken, the identification of loose bolts is an especially daunting one, in particular when this operation concerns large structures located in poorly accessible or unsafe environments (offshore platforms, bridges, railtracks, etc.). At present there are no commercially-available technologies which enable to perform loose bolt identification in a reliable, safe and fast manner, thus requiring a one-by-one measurement of the screwing torque of each bolt. A newly patented technique filed by the Japanese partners of this project uses laser ablation to trigger high frequency vibrations in large portion of a structure. By studying these high frequencies vibrational responses, it is possible to identify which bolt have come loose. This technique has so far been successfully demonstrated in the case of a small-scale metallic plate with a limited number of bolts. Upscaling this protocol to large-scale structures requires interpreting the subtle changes in the vibrational modes from a default state. This project aims to develop a machine learning technique which analyses the pre and post modal frequency response of a generic, large-scale structure from laser ablation testing and uses this data to accurately identify the loose bolts.



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