PhD. Research Proposal

Title : 3D Crack prediction and Modeling on Civil Infrastructures for Safety Health Monitoring

In order to increase the life cycle of structures a regular monitoring is often required to detect damages and any cracks that may lead to dangerous and quick collapse of the structures (1,2). Damage detection using non-destructive techniques is highly required in many engineering domains where the structure cannot be destroyed or complicated to reach or to stop running such as in offshore structures, civil engineering, etc,. Most of these techniques for non-destructive damage and crack detection require image analysis with a high definition that require time consuming and HPC. Most of the study cases that we can find in literatures these recent years are often a basic structure.

Actually, with the development of the new smart algorithms and hybrid surface response of large amount of data, once, can combine the advantage of such approaches for structural optimization and to converge into one reliable and more general non-destructive damage detection technique that can be applied with efficiency to global 3D structures. The purpose of this research project, is to develop a new approach that combines image and signal analysis techniques with advanced strategies. Then, once can use the new technique for non-destructive damage and crack detection. Advanced learning allows the surface response to process image data with a super brain ability and predict the damage faster and more accurate both 2D and 3D model (3).

Results should be demonstrated numerically and experimentally on a 3D complex structures. The numerical analysis, is based on finite element method FEM using cyclic progressive loading. The FEM will be coupled with the optimization process based on advanced hybrid optimization strategies. For the experiment testing, we may adapt an ultrasound/ laser scan material to create the images data base.

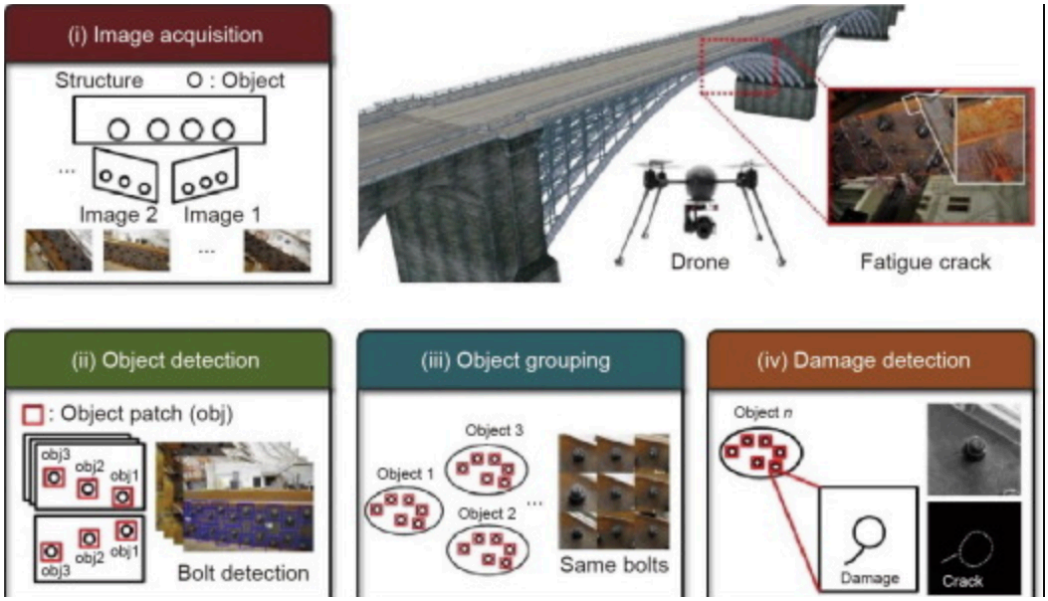
The applications of such research are very larges such in civil engineering structures and in all industries that require to increase the life cycle of their structures and to reduce the total cost under various mechanical constraints for Safety Health Monitoring.

Key words: Crack prediction; Modeling; Safety Health Monitoring.

References :

1. B.F. Spencer Jr. et al., *Advances in Computer Vision-Based Civil Infrastructure Inspection and Monitoring*/Engineering 5, 199–222, 2019.
2. S.K. Dwivedi, M.Vishwakarma, A. Soni, Advances and Researches on Non Destructive Testing: A Review, 7th International Conference of Materials Processing and Characterization, March 17-19, 2017, https://doi.org/10.1016/j.matpr.2017.11.620, V. 5, Issue 2, Part 1, 2018, pp. 3690-3698.
3. C.M. Yeum, S.J. Dyke, Vision-based automated crack detection for bridge inspection, Comput Civ Infrastruct Eng, 30 (10), pp. 759-770. 2015

Example of application for civil engineering



Vision-based automated crack detection for bridge inspection in Ref. [1].