Metaheuristic Techniques for Automatic Detection of Denting Damage in an Offshore Jacket Platform

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Abstract. Over decades, the interest in developing techniques for long-term online monitoring of aging engineering structures has greatly increased. Instead of inspecting the system at fixed time intervals, researchers want to monitor its health in service, by continuously extracting characteristic parameters that allow conclusions to be drawn on the structure's useful remaining lifetime, the next repair/maintenance, or the need for immediate shutdown. Motivated by concept of smart structure (with respect to its dynamic behavior), an existing structure is to retrofit with a set of sensors. To see if structural condition has changed, the actual measurement data have to be evaluated and compare to the reference values which derive from the undamaged state of the monitored system through time frequency representations. However, it can be very difficult to link the evaluation of the measurement data with the physical interpretation of the damage states. For these reasons, the vibration-based structural health using metaheuristic approach should be advantageous. By applying this technique, the damage detection is considered as an optimization inverse problem and the unknown parameters of damage can be forecasted automatically and accurately through the deviation minimization between experimental and simulated vibration responses. This research discusses the use of adaptive metaheuristics algorithm to provide an automatic detection of denting damage in an offshore structure. A model is developed combining with the percentage of the dent depth of damaged member diameter and is used to assess the performance of the method. To investigate the performance, the proposed technique is used to solve the optimization problem and compared with other well-known self-adaptive metaheuristics. Then the Wilcoxon rank sum test is used to rank and compare the performance of the technique among all MH optimizers. It is demonstrated that good results are obtained with accuracy and lower computational time for the case of localization of dent damage occurring simultaneously in jacket legs and diagonal braces after impacts or ship collisions.

Keywords: Denting damage, offshore jacket platform, finite element model, natural frequency, mode shape, metaheuristic.