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THE PERFORMANCE OF A MODIFIED HARMONY SEARCH ALGORITHM IN THE STRUCTURAL IDENTIFICATION AND DAMAGE DETECTION OF A SCALED OFFSHORE WIND TURBINE LABORATORY MODEL

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Abstract: Offshore wind turbines are subjected to harsh environmental and operational conditions that affect their dynamic properties and cause damage. Visual checks are, for economic reasons, kept as low as possible, thus making the ability to detect damage via transmitted measurements a vital issue. Identifying a structure is considered in essence an inverse problem in which the stiffness, mass and damping properties are determined based on the measured outputs, i.e. vibration response. Amongst other structural identification techniques, model-updating methods based on vibration data have proven to fit well for the identification of such structures. Such model-updating schemes treat the identification problem as an optimization problem, which can be well-solved using meta-heuristic optimization schemes. The objective of this study is to investigate the performance of the harmony search algorithm, both basic and modified, in identifying a scaled laboratory model of an offshore wind turbine supporting structure and detect its damage. The laboratory model is tested in a wave basin and is subjected to a variety of damage and marine growth levels. The harmony search algorithm variants that are investigated include the basic harmony search algorithm, a modified adaptive harmony search algorithm, and the later with a modified search space reduction scheme. The investigation shows promising results, especially for the case of harmony search coupled with a search space reduction scheme, and provides further suggestions on how to improve the performance even further.