APPLICATIONS OF EXPANSION TECHNIQUES IN OPERATIONAL MODAL ANALYSIS

In civil engineering there is a tendency towards structures being designed with a more and more slender design. When building advanced civil structures as offshore platforms and wind turbine, there is a high focus optimizing the design and thereby save materials and decrease the total cost of the structure. This can sometimes result in structures being sensitive to dynamic loading, like wind acting on the blades of a wind turbine, or waves acting on an offshore platform. The negative effect of this can be an unreasonable vibration level and faster accumulated fatigue, which can weaken the material.

The main focus of this project is to develop a model that provides information about the dynamics of a structure in points where no sensors have been placed. This is done by making a transformation between a set of experimentally obtained mode shapes and a set of mode shapes from a Finite Element Model (FE). The overall principle is that a set of mode shapes can be described as a linear combination of another set of mode shapes as long as the changes between the two models are small. This is known as the Local Correspondence Principle. The set of experimentally found mode shapes can be found by making an Operational Modal Analysis on the measured response and has the advantage of providing "true" information in a limited number of points. On the other hand, the FE model provides a set of "fictive" mode shapes in a large number of points. As long as the FE model doesn't differ too much from the real structure, the estimated mode shapes can successfully be found making a linear transformation of the FE mode shapes.

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The proposed method can be used in the health monitoring of structures, to predict the current stress-history of the structure, and thereby give an estimate of the accumulated fatigue.

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