

EXAMPLE OF POSSIBLE OUTCOMES OF A LONG-TERM DYNAMIC MONITORING CAMPAIGN ON AN OFFSHORE WIND TURBINE USING STATE-OF-THE ART AUTOMATED OPERATIONAL MODAL ANALYSIS TECHNIQUES

1. Measurement Setup and Measured Accelerations

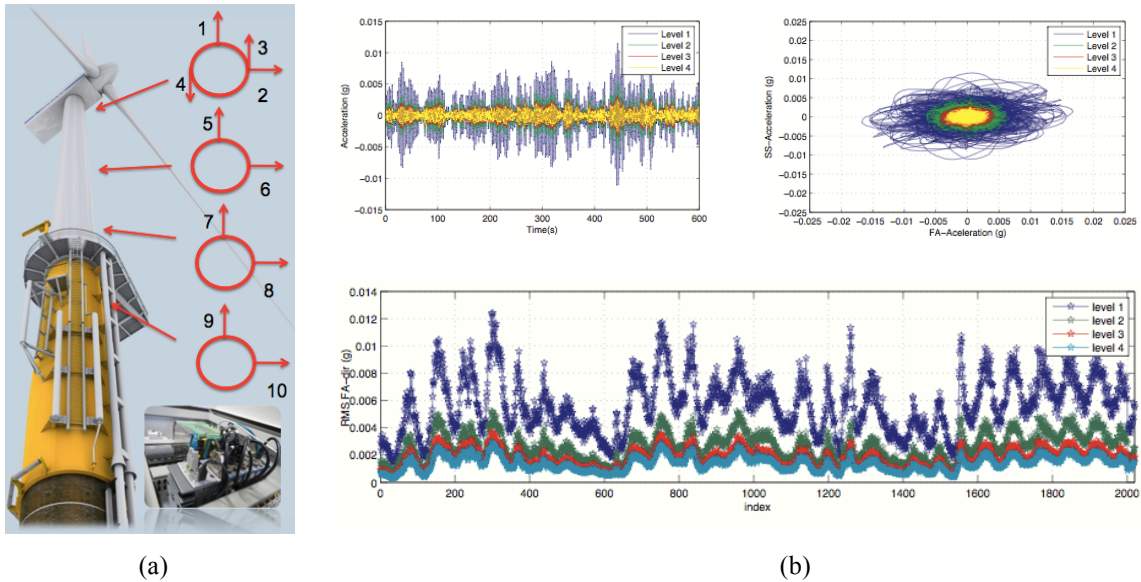


Figure 1. (a) Example of measurement locations and data acquisition system (b) example measured accelerations during ambient excitation on 4 levels, with level 1 the highest level, in the fore-aft direction (top left) and movement seen from above (top right) example of daily variation of the root mean square (RMS) values of the acceleration time series in the FA-direction (bottom)

2. Identified Modal Parameters: resonant frequencies, damping values and mode shapes

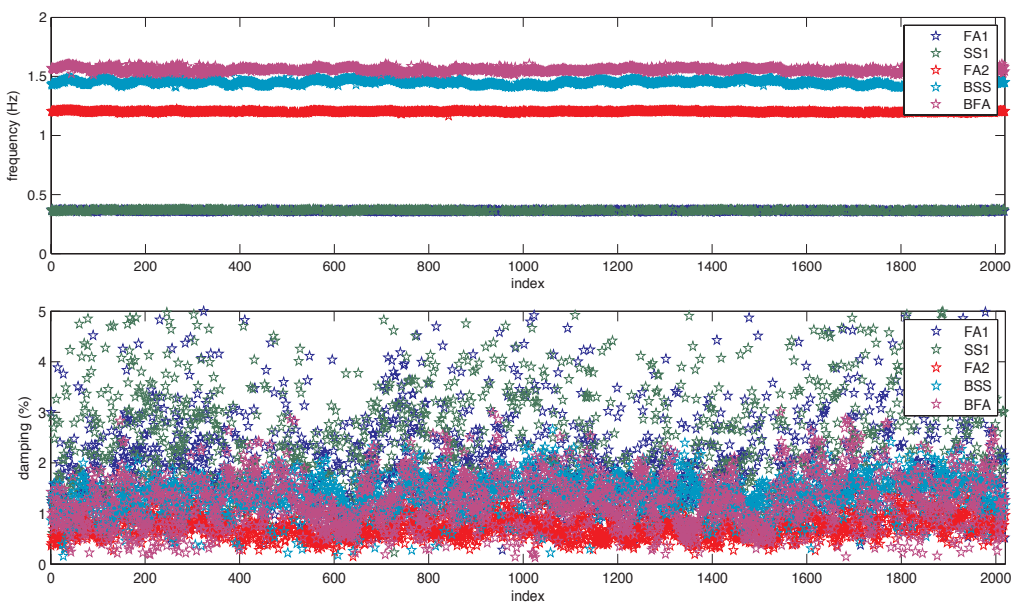


Figure 2. Example of evolution of frequencies (top) and damping (bottom) of the 5 dominant modes during a monitoring period.

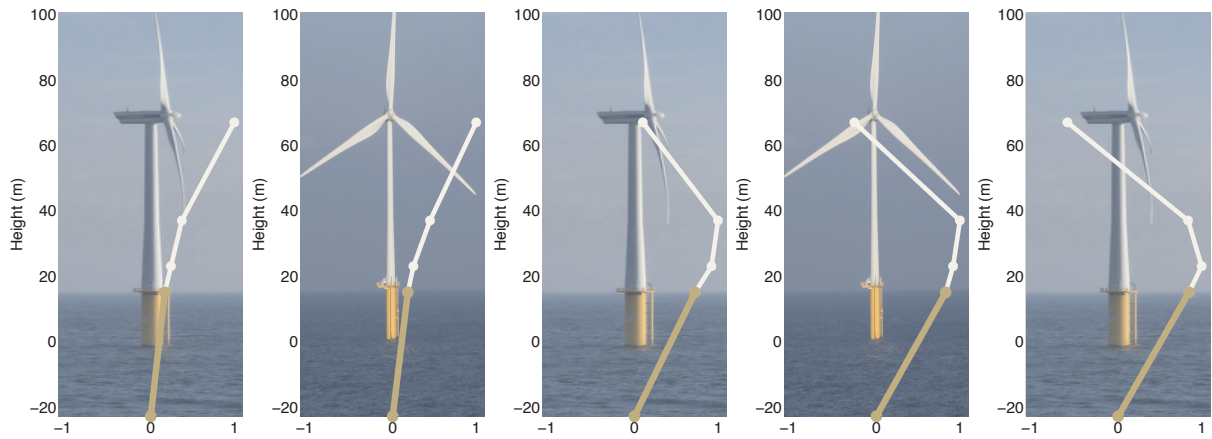


Figure 3: Example of five dominant identified mode shapes identified during a monitoring period: from left to right: first fore-aft bending mode, (FA1) first side-side bending mode (SS1), mode with a second fore-aft bending mode tower component (FA2), mode with a second side-side bending mode tower and nacelle component (SS2N), mode with a second fore-aft bending mode tower and nacelle component (FA2N)

1. Statistical analysis of identified modal parameters

Mode	Success Rate (%)	Mean Freq (Hz)	Std Freq (Hz)	Mean damp (%)	Std damp (%)	Mean MAC	Min MAC
FA1	72	0.3614	0.0039	1.863	0.853	0.91	0.80
SS1	50	0.3656	0.0045	2.491	0.969	0.90	0.80
FA2	97	1.2007	0.0055	0.721	0.221	0.98	0.80
BSS	94	1.4489	0.0178	1.383	0.334	0.98	0.81
BFA	88	1.5600	0.0162	1.141	0.489	0.95	0.80

Table 1. Example of an overview of the identified modal parameters of the 5 dominant modes during a monitoring period.

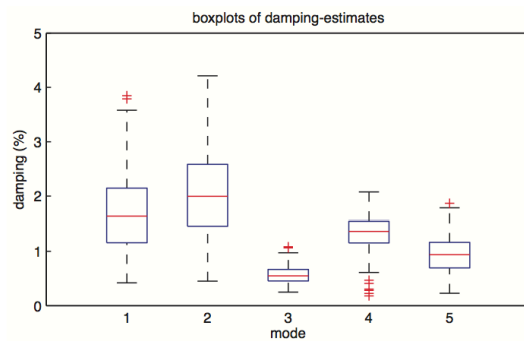


Figure 3. Example of a statistical analysis of damping values of the 5 dominant modes during a monitoring period.