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Single Component Hybrid Simulation on a Wind Turbine Blade

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Abstract

Hybrid simulation is a sub-structural testing and analysis concept with the emulated structure partitioned into an experimental- and analytical substructure. When combining the response of the two substructures, the behavior of the emulated structure is obtained. The experimental substructure is a physical test, which provides the capability to isolate and test a critical component, which displays complicated structural behavior e.g. buckling, viscoelastic behavior, etc. The remainder of the structure is well understood and for that reason simulated in a numerical model. The coupling between the experimental and numerical substructure is achieved by maintaining the compatibility and equilibrium at the shared boundary.

The research within hybrid simulation has been focusing on testing of e.g. fluid dampers for seismic protection of building structures [1], [2] and [3]. In these tests – referred to here as multi component hybrid simulation - the shared boundary between the experimental- and numerical substructure is clearly defined by a discrete point with a few degrees of freedom. However with the aim of performing hybrid simulation on a single component structure e.g. wind turbine blade, boat hull, etc. the shared boundary conditions between the two subcomponents becomes significantly more complicated. This is caused by the continuous boundary between the two models, resulting in an infinite amount of degrees-of-freedom.

With an outset in a hybrid simulation platform provided by MTS, a single component hybrid simulation on a 34m wind turbine blade from SSP technology is conducted. Here the

experimental substructure is handled in a fatigue rated test setup for structural assessment of the inner 8m root section. The numerical substructure comprises the remainder of the emulated structure, which is described in a FE-formulation. The partitioning between the two substructures – referred to here as the shared boundary - is defined by a discrete point with three dofs including translation in the x and y-direction along with rotation around the z-axis – referred to here as `f`. A sketch of the emulated structure separated in the experimental and numerical substructure is presented in figure 1.

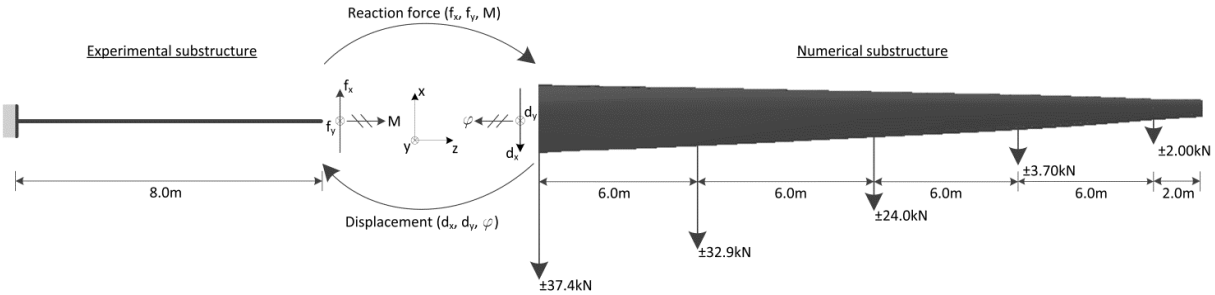

Figure 1. Wind turbine blade separated in an experimental and numerical substructure.

References

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