Enhancing Structural Performances Of Offshore Wind Turbines Using Track Nonlinear Energy Sinks

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Offshore wind turbines (OWTs) are dynamically sensitive to external excitations (such as wind, sea waves and earthquakes) as they are currently built with increasingly long blades and slender towers to more effectively harness wind resources in marine environments. Extensive efforts have been devoted to controlling excessive vibrations of OWTs, and most focused on tuned mass dampers (TMDs) with control performances sensitive to frequency contents of excitations and frequency changes of structures. Track nonlinear energy sinks (NESs) have recently been proven effective in broadband vibration control but also possess amplitude-dependent control performance. In the present study, track NESs are newly designed to improve their performance and to further mitigate structural responses of OWTs. A detailed three-dimensional finite element model of a typical 5MW OWT is developed in ABAQUS, and the modelling method of track NESs is also given. The control effectiveness of track NESs is comprehensively examined under different dynamic loads and structural frequencies and compared with that of linear TMDs. Numerical results indicate that the proposed track NESs can effectively suppress displacement and acceleration responses of OWTs, and their reduction ratios are comparable with TMDs but with better robustness against the detuning effect, implying that track NESs have promising applications in enhancing structural performances of OWTs under harsh ocean conditions.