

Using Toroidal Tuned Liquid Column Dampers To Mitigate Monopile Wind Turbine Vibrations Bidirectionally

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This study investigates the bidirectional vibration control performance of a toroidal tuned liquid column damper (TTLCD) in a monopile wind turbine. The TTLCD has the advantage that it can be tuned to match the natural frequencies of wind turbines in fore-aft and side-side directions simultaneously. Firstly, a three-dimensional numerical model is developed on ANSYS platform. Simulations are performed to demonstrate that the liquid responses of TTLCDs excited bidirectionally can be estimated by those excited unidirectionally, which establishes a basis for the mathematical modeling of TTLCDs bidirectionally. Subsequently, numerical simulations are carried out for monopile wind turbines equipped with TTLCDs considering fatigue and ultimate loads based on the FAST program. The results prove that the TTLCD is effective for bidirectional vibration control, and provide significant insights into the control efficiency and damping mechanism of TTLCDs installed in monopile wind turbines.