Cost reduction of floating wind turbine substructure by tuned liquid damper assisted robust control

Wei Yu*[1], Shengtao Zhou , Frank Lemmer , and Po Wen Cheng

[1]University of Stuttgart – Germany

Abstract

Earlier work has shown promising result of adapting a passive Tuned Liquid Column Damper (TLCD) to floating wind turbines (FWT). Because of the additional damping introduced by TLCD system in the platform pitch direction, the blade pitch controller can be redesigned. The standard deviation of power production of the DTU 10MW turbine supported by the TripleSpar can be reduced approximately by 25%. This improved power production is achieved by using robust baseline controller and the tower base bending moment is not deteriorated, which is normally not the case due to the negative damping problem of FWTs. In this work, detailed sensitivity study of TLCD geometries and damping will be first carried out, which can lead to a better-designed TLCD with more efficient performance. As a next step, an integrated optimization loop including automatic TLCD and controller design will be setup. The objective is to minimize the manufacturing cost of platform. The platform motion, tower-top displacement, as well as fairlead fatigue damage will be defined as constrains which limit the dynamic response. The result is expected to deliver more compact and light weighted substructure design, which has comparable good dynamic behavior.

Keywords: Floating wind turbine, optimization, tuned liquid column damper, controller design

*Speaker