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ADVANCES IN STRUCTURAL MODELLING AND SIMULATION OF WIND TURBINES

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ABSTRACT

Faced with a future scenario of scarcity of fossil fuels and large impacts on the environment, the use of renewable energy sources has become wide object of studies that seek to diversify the global energy mix.

Wind power generation is a source of renewable, clean and low environmental impact energy. It is available at many places around the world. The use of this energy source to generate electricity commercially was driven by the global oil crisis in the 70s. Nowadays, Europe and the United States have developed this technology to reduce its dependence on fossil fuels. Currently maturity of wind as a source of electricity production is a reality in the world. This can be proven by the large number of wind farms connected to the power grid at all voltage levels. In late 2018, the installed capacity of wind turbines was about 600 GW, with a growth of over 10% market share compared to 2017.

The use of turbines for energy recovery is characterized as a low environmental impact conversion process, which can represent innovative solutions in the context of energy local, regional or national headquarters.

This can increase the efficiency and the amount of the productive capacity and can make such a resource more cost-effective if the plant is durable and operates with minimum stoppage through its life. In order to reach such a goal the numerical modeling of these structural systems plays a crucial role, as they are composed by different parts with several distinctiveness and subject to severe and more complex environmental conditions than inshore wind turbines, owing to the additional presence of the hydrodynamic and hydrostatic loads.

Unexpected failures of wind turbine components, such as blades and towers are related to up to 40% of a wind farm cost. Reducing maintenance costs and extend wind turbines lifespan is a challenge[1].

Different aspects and various performances under several load conditions have to be investigated for this type of structures. Referring to all possible system configurations considered for the blades and the rotor, it is necessary to:

a. make certain that the components are designed for the extreme loads allowing a fair survivability;
b. assure that the fatigue life of the components is guaranteed for the service life;
c. define component stiffness with respect to vibrations and critical deflections in a way that the behaviour of the turbine can keep under control by a careful matching of stiffness.

In doing so, a breakdown of the structural system becomes an essential step in the early study [2].

The aim of this mini symposium is to bring together researchers in computational mechanics, computer science, engineering and applied mathematics, and practitioners in wind energy systems, to tackle the problems of computer-based modelling & simulations of this kind of structural systems.

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