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Keynote lecture title:
Concept, design, manufacturing, setting-up, maintenance: a machine whole life together with advanced technologies in structural dynamics for improving renewable energy systems.

Keynote lecture abstract:
Wind turbines, solar panels and kinetic energy storage systems are becoming interesting tools in smart electricity harvesting and distribution strategies. The combination of renewable, but often discontinuous, sources like wind and solar energies, with chemicals-free storage solutions is appealing for its lower impact on the environment, together with its better balance of non uniform energy production and consumption in the long term. The embodiment of these needs passes through complex machines, where their structural dynamics is of absolute relevance during their whole life: from the concept of the machines, to the design, prototyping and testing, to the manufacturing of their parts and assembling, to the proper setting up and running in real loading conditions, till the accurate maintenance for long-life service. Failures in any of the previous steps can undermine the economic sustainability of this challenging asset.
The focus of this talk is on the best usage of measurement technologies and related analyses to improve the understanding of the loading phenomena and of the structural response of the machine through all the phases of its life, for an advanced knowledge-based design, manufacturing and service.
The enhancements of distributed sensor technologies offer nowadays significant insights on the mechanical behavior of the components. Among them, full field optical techniques can explore the structural dynamics in the finest spatial detail, along with the frequency domain information, which can be crucial for the adherence of the predictive models to reality. Other sensing techniques are approaching the higher spatial description, for a clear enhancement of the numerical models, also in a hybrid frequency-based domain. When components are optically accessible, full field technologies can improve the understanding of the structural mechanics also with new quantities, like rotational degrees of freedom and dynamic strain maps, with unprecedented precision.
But again it is the concurrent hybrid approach of all the best technologies available that gives the accurate understanding of the boundary and loading conditions among which the machine will have to work. The sure characterization of the dynamic signature of loading, also induced by controls and actuation, is the basic step in developing a physically sound machine structure.
The advanced techniques shown become fundamental in the prototyping of reliable models and pre-production samples, to reduce the iterations in the procedures to refine the models for minimal risk predictions.
Optical techniques have proven to be sensible to very small defects also in composite structures, therefore they can aid the manufacturing controls to grade the quality of production and failure expectations, for more economic but safe component exploitation, which is also open to cheaper manufacturing. The cross correlation of manufacturing defect size and location, together with the awaited excitation, can map the endurance of a component for failure expectations, thus the risk of a component break.
But structural dynamics tools are a good companion also of a sound mounting, assembly and tuning of the complete machine, to suppress avoidable and unwanted loading.
Hybrid technologies continue therefore to serve as a life-long partner in the constant monitoring and surveillance of complex machines under real-life scenarios for updated life predictions and maintenance, to avoid service interruptions, to collect refined databases to improve the whole machine concept realization, and to lead to a more sustainable and environmentally friendly energy production.