Pattern recognition and damage detection in the energetica 2030 wind turbine fiber glass tower through machine learning

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ABSTRACT

In a world leading toward the systematization of task, current tools, like machine learning, aim to spare time, energy and most importantly, increase safety. In SHM these kinds of technologies provide faster, cheaper and better monitoring to recognize flaws or damage in general structures. Following the project of ENERGETICA 2030, a project founded by the Ministry of science in the in the frame of the program *Colombia científica*, leaded by the Univercidad Nacional de Colombia and financed by the world bank in view to promote the research capacity of the local universities focused to modern problems like green energies, a study of the structural behavior of a rural wind turbine has been done through machine learning to recognize behavior patterns and detect possible damage in a fiber glass tower. The methodology is based in a local characterization with strain gauges, and a general characterization with accelerometers, installed at various heights of the tower. With partial sensing of environmental variables and total control of the structural components, like the guy cables tension and bolt base's tightening, it's possible to induce controlled damage, like a loose bolt or an increase of the tower rigidity by increasing the guy cable tension. Once the undamaged data is acquired, it can be proceeded to generate the induced damage and acquire the new data which will feed an algorithm (Neural Network). Once trained, the system will recognize the occurrence and the type of damage. The accelerometers giving the general behavior, like a pause in the process of lifting or a guy cable break (strong acceleration about 2 m/s suddenly) or a tendency of the tower to bow (significant change of the local strain slope, stair-like). As the world seeks sustainable alternatives to fossil energy, the number of off-shore wind turbine has increased, as well as smaller prototypes for houses and rural zones. With this in mind, it's important to provide an unsupervised automatized system who monitors the structural health, to ensure the safety and increase the lifetime of the structure, even more with structures based on composite material.