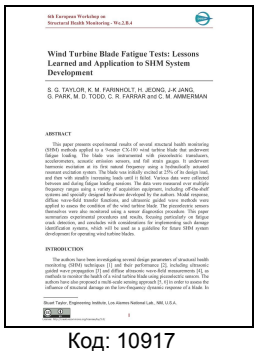

Код: 10917

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Wind Turbine Blade Fatigue Tests: Lessons Learned and Application to SHM System Development

Дрезден, Германия, 2012 год

8 стр; формат: 23,5 x 16 см; библиографический список: 12 единиц

This paper presents experimental results of several structural health monitoring (SHM) methods applied to a 9-meter CX-100 wind turbine blade that underwent fatigue loading. The blade was instrumented with piezoelectric transducers, accelerometers, acoustic emission sensors, and foil strain gauges. It underwent harmonic excitation at its first natural frequency using a hydraulically actuated resonant excitation system. The blade was initially excited at 25% of its design load, and then with steadily increasing loads until it failed. Various data were collected between and during fatigue loading sessions. The data were measured over multiple frequency ranges using a variety of acquisition equipment, including off-the-shelf systems and specially designed hardware developed by the authors. Modal response, diffuse wave-field transfer functions, and ultrasonic guided wave methods were applied to assess the condition of the wind turbine blade. The piezoelectric sensors themselves were also monitored using a sensor diagnostics procedure. This paper summarizes experimental procedures and results, focusing particularly on fatigue crack detection, and concludes with considerations for implementing such damage identification systems, which will be used as a guideline for future SHM system development for operating wind turbine blades.

Доклад. 6-я Европейская конференция по мониторингу технического состояния сооружений, 2012. Редакция Кристиана Боллера.

Ключевые слова:

Содержание