Monitoring-Driven Life-Cycle Assessment of Wind Turbines

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We present an integrated approach toward Monitoring-driven Life-cycle assessment of wind turbine structures. A major challenge in efficient condition assessment and residual life prediction for such systems lies in their continual exposure to highly stochastic loads due to varying environmental and operational conditions. In the context of the ERC StG project WINDMIL, we develop tools that are able to tackle the lack of precise loading information, as well as the operational, environmental and modelling uncertainties, toward the structural health monitoring, damage detection and life-cycle assessment for wind turbine components across two temporal scales, namely the short-term (gusts, extreme turbulence, faults) and long-term (fatigue). We propose a novel framework that combines an easily deployed and relatively cheap sensor network, with state-of-the-art data processing methodologies with the standard stream of condition monitoring data (SCADA). We present the main thesis of this framework and illustrate its various building blocks, such as physics based and data driven modelling, data fusion, fatigue and life cycle assessment and decision making process.