
Novel Implementations of Direct Online Rainflow-counting in Model Predictive Control for Fatigue-Reduction

Stefan Loew^{*1}, Carlo L. Bottasso², and Dragan Obradovic³

¹TU Munich, Siemens AG – Germany

²TU Munich – Germany

³Siemens AG – Germany

Abstract

Nonlinear Model Predictive Control (NMPC) of wind turbines is an aspiring control method for balancing production of electric energy and fatigue of specified components. In a recent publication [1], the implementation of the standard fatigue estimation method including Rainflow-analysis in MPC has been shown. The method called "Direct Online Rainflow-counting" (DORFC) results in an advantageous shaping of mechanical stress over time and higher profit in comparison to conventional MPC formulations. One key aspect is the modification of the structure of the fatigue cost function at every MPC-step. In the present talk, new methods will be shown which enable this modification in conventional MPC-suites like ACADO Toolkit. One novel method will be the formulation of a Tracking MPC problem. A second novel method will be based on a parameter-variant Economic MPC problem. Further research steps will be shown, where estimations of past stress are included in the fatigue cost function, and where robustness of the MPC is increased by uncertainty quantification. [1] S. Loew, D. Obradovic and C. L. Bottasso, "Direct Online Rainflow-counting and Indirect Fatigue Penalization Methods for Model Predictive Control", European Control Conference 2019, 2019.

Keywords: Model Predictive Control, Fatigue, Rainflow

^{*}Speaker