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Optimal Reliability in Design for Fatigue Life

Fatigue describes the damage or failure of material under cyclic loading. Activation and deactivation operations of technical units are important examples in engineering where fatigue and especially low-cycle fatigue (LCF) play an essential role. A significant scatter in fatigue life for many materials results in the necessity of advanced probabilistic models for fatigue. Moreover, structural shape optimization is of increasing interest in engineering, where with respect to fatigue the cost functionals are motivated by their predictiveness for the integrity of the component after a certain number of load cycles. But mathematical properties such as the existence of the shape derivatives are desirable, too. Deterministic design philosophies that derive a predicted component life from the average life of the most loaded point on the component plus a safety factor accounting for the scatter band do not have this favorable property, as taking maxima is not a differentiable operation. In this work we present a new local probabilistic model for LCF. This model constitutes a new link between reliability statistics, shape optimization and structural analysis which considers the perspective of fatigue but also fits into the mathematical setting of shape optimization. As a main result, we show the existence of shapes of optimal reliability for the case of domains with sufficiently regular boundaries. This talk is based on joint work with Sebastian Schmitz (ICS Lugano and Siemens Energy).

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Zu diesem Vortrag laden wir Sie herzlich ein.

gez. Prof. Dr. Alfio Borzi