Design of Crankshaft Main Bearings under Uncertainty.

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ABSTRACT

A probabilistic analysis is presented for studying the variation effects on the main bearing performance of an I.C. engine system, under structural dynamic conditions. The analysis is based on surrogate models (metamodels), which are developed using the kriging method. The metamodels provide an efficient and accurate substitute to the actual engine bearing simulation models. The bearing performance is based on a comprehensive engine system dynamic analysis which couples the flexible crankshaft and block dynamics with a detailed main bearing elastohydrodynamic analysis. The clearance of all main bearings and the oil viscosity comprise the random design variables. Probabilistic analyses are performed to calculate the mean, standard deviation and probability density function of the bearing performance measures. A Reliability-Based Design Optimization (RBDO) study is also conducted for optimizing the main bearing performance under uncertainty. Results from a V6 engine are presented.

keywords: I.C. engines, crankshaft, main bearing elastohydrodynamic analysis, engine system dynamics, surrogate modelling, design under uncertainty, reliability-based design optimization