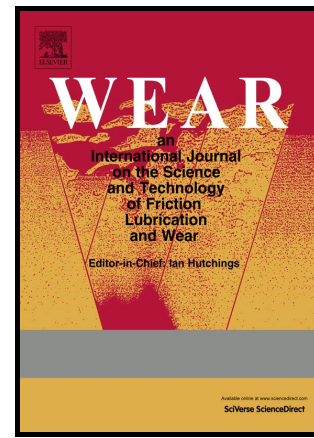


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Transient wear simulation based on three-dimensional finite element analysis for a dry running tilted shaft-bushing bearing

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1 Transient wear simulation based on three-dimensional finite 2 element analysis for a dry running tilted shaft-bushing bearing

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7 Abstract

This paper presents a method to predict dry sliding wear. It is developed for the wear simulation on a tilted shaft-bushing bearing of an automotive turbocharger wastegate system. Therefore the simulation of complex dynamic behavior with its respective contact situations is required and is performed by nonlinear, transient, three-dimensional finite element analysis (FEA). Simultaneous wear calculation on all contact surfaces is possible considering individual wear coefficients. In order to reduce computing time, the resulting ablation depth is extrapolated. Subsequently the mesh is adjusted by implementing nodal displacements. The progress of the calculated wear volume matches well with theoretical considerations for different mesh qualities. Mesh refinement only leads to a higher resolution of the results but good convergence is achieved.

8 1. Introduction

9 Downsizing of combustion engines is a common strategy to fulfill stricter emis-
10 sion regulations. In order to still meet the engine performance targets, turbocharg-
11 ers are used to increase the specific power output of smaller engines. A bypass
12 valve (wastegate) is used to control the boost pressure produced by the turbocharger.
13 The kinematic system which actuates the wastegate contains a shaft-bushing bear-
14 ing. This bearing experiences complex load situations and is vulnerable to wear.

15 Wear reduction is an essential element in extending lifetime. Colbert *et al.*
16 have shown that the durability of shaft-bushing bearings can be improved by de-
17 sign optimization [1]. According to Wibmer *et al.* time consuming and expensive
18 experiments are one approach to understand and optimize wear behavior [2]. An-
19 other approach is simulation, which contributes to this optimization and leads to
20 faster and more efficient development.

21 Wear can be simulated for lubricated and for dry running systems. Lubricated
22 tribosystems are part of many important applications and a large variety of scien-
23 tific work is dedicated to them. For example Debler [3], Schmidt [4] and Frölich

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