The 8th European Congress on Computational Methods in Applied Sciences and Engineering
ECCOMAS Congress 2022
5 – 9 June 2022, Oslo, Norway

Multi-physical modelling and analysis of lubricated transmissions using a coupled finite element approach

S. Neeckx*[1,2], B. Blockmans[1,2], W. Rottiers[1,2] and W. Desmet[1,2]

[1] KU Leuven, Departement of Mechanical Engineering
Celestijnenlaan 300, B-3001, Heverlee, Belgium
E-mail: sander.neeckx@kuleuven.be
[2] DMMS-lab, Flanders Make
Gaston Geenslaan 8, B-3001, Heverlee, Belgium

Key Words: *Multiphysics Problems, Applications, Computing Methods.*

Lubrication is vital to improve performance, efficiency and durability in transmissions; it serves to minimize wear, noise, vibration and friction. The proper functioning of lubricated transmissions relies on interactions amongst a wide range of physical phenomena (contact dynamics, fluid-structure interaction and heat transfer) operating at different spatial and temporal scales. Accurate information regarding key states and parameters is required in order to improve the performance, efficiency and durability.

The purpose of this contribution is combining the lubricant [1] [2], temperature [3] and elastic [4] domain in a coupled multi-physical transmission model, based on first-principle distributed-parameter models. Reynolds' equation and the energy equation for the fluid domain are combined with the linear solid continuum equations and Fourier's law for the structural domain. All equations are discretised according to the finite element method.

The developed multi-physical model is then used to investigate the dynamic performance of a geared transmission and in particular to assess the influence of the lubricant film and temperature distributions on the transmission's key performance indicators, including transmission errors and gear root bending stresses.

REFERENCES

[1] O. Reynolds, "On the Theory of Lubrication and Its Application to Mr. Lowe's Experiments, Including an Experimental Determination of the Viscosity of Olive Oil", *Philosophical Transactions of the Royal Society of London*, pp. 157-234, 1885.

[2] B. J. Hamrock, S. R. Schmid & B. O. Jacobson, Fundamental of Fluid Film Lubrication, New York: Marcel Dekker, Inc., 2004.

[3] R. B. Hetnarski & M. R. Eslami, Thermal Stresses - Advanced Theory and Applications, Springer, 2009.

[4] A. A. Shabana, Dynamics of Multibody Systems, New York: Cambridge University Press, 2013.