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Comparison of loaded tooth contact analysis of static and dynamic domain

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ABSTRACT

This study aims to develop the already thorough procedures [1], [3] of the structural analysing methods of gear train simulations of medium speed engines and provide profound information of the basics of contemporary gear wheel simulations. Multibody dynamic (MBD) simulations (Figure 1) have been exploited alongside more traditional analytical methods as a form of two different software both of which utilize the different calculation method, a dynamic loaded tooth contact analysis and a static loaded tooth contact analysis. AVL Excite is selected as MDB solver for the study due to many outcomes supporting it as the superior development tool in engine simulations, see [4], [1]. The main research questions of this study are the following: are the results of loaded tooth contact analysis between these software comparable and what are the phenomena and parameters to have a great impact on gear wheel simulations. To answer these questions, a comparable study between the two software and a sensitivity study of variables have been made [2].

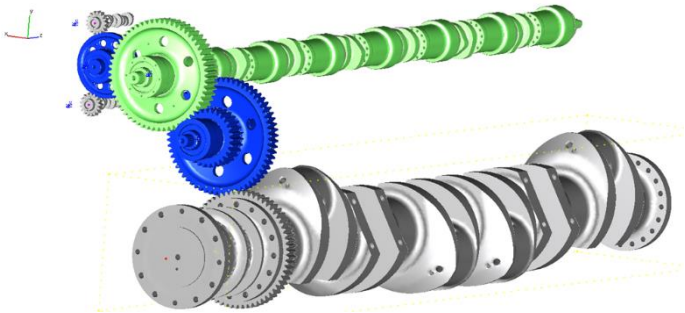

Figure 1. Layout of the studied multibody dynamic model.

The results from the comparison study between software showed that they are comparable with a good correlation. The basic equations in both software considering the gear tooth stiffness definition are similar, but the characteristics of dynamic versus static calculation sets many different properties that need to be considered. For the sensitivity study, a selection of varied parameters was made that included backlash, damping, friction coefficient, wheel body deformation theory and the amount of retained centre nodes. Based on the results of the sensitivity study, it is clear that the amount of backlash has a significant effect on the stress and force results while the effect of damping and friction variation is almost negligible. The selection of the wheel body deformation has a moderate effect on all results and, thus, the simulation model needs to be correctly assembled. The results of this study provide a good basis for further development of the simulation methodology and the validation via measurements that will be done in the future.

Keywords: gear wheel stress analysis, multibody dynamics, slice method, meshing stiffness, sensitivity.

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