Simulation and Analysis of Roller Chain Drive Systems

The subject of this thesis is simulation and analysis of large roller chain drive systems, such as e.g. used in marine diesel engines. The aim of developing a chain drive simulation program is to analyse dynamic phenomena of chain drive systems and investigate different design changes to the systems, in order to remove unwanted phenomena. Such a computer program can, when properly validated, be used as an alternative to or in combination with physical experiments. Prior investigations in this area have been done with a focus on smaller chains in high speed chain drives. For large low speed systems other phenomena occur and therefore, a specific model of the marine engine chain drive is of interest. The research objective of the work presented in this thesis is to contribute with a novel theoretical basis for the analysis of chain drive systems, by posing and validating different mathematical models, and compare to the prior done research. Even though the model is developed at first for the use of analysing chain drive systems in marine engines, the methods can with small changes be used in general, as for e.g. chain drives in industrial machines, car engines and motorbikes. A novel formulation for the simulation of the dynamics of roller chain drives using a continuous contact force method is developed in this work. The model of the contact surface between the rollers and sprocket has shown to be an important issue regarding the numerical stability of the simulation program and a model with a real tooth profile proves superior to other applied models. With this model it is possible to perform a dynamic simulation of large marine engine chain drives. Through the application of this method, it is shown that the interrelated dynamics of the elements in the chain drive system is captured and the contact problem is characterized. The chain drive model is compared with simplified analytical results, while the necessary experimental validation is left for future studies.

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