Kinematic and dynamic modeling and approximate analysis of a roller chain drive - DTU Orbit (08/11/2017)

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A simple roller chain drive consisting of two sprockets connected by tight chain spans is investigated. First, a kinematic model is presented which include both spans and sprockets. An approach for calculating the chain wrapping length is presented, which also allows for the exact calculation of sprocket center positions for a given chain length. The kinematic analysis demonstrates that the total length of the chain wrapped around the sprockets generally varies during one tooth period. Analytical predictions for the wrapping length are compared to multibody simulation results and show very good agreement. It is thereby demonstrated that chain drives with tight chain spans must include compliant components to function. Second, a dynamic model is presented which includes the two spans and the driven sprocket. Assuming the presence of a stationary operating state, the presented dynamic model allows for analytical studies of the coupled motion of the chain spans and driven sprocket. Parametric excitation of the spans come from sprocket angular displacements, and the driven sprocket acts as a boundary which can be compliant in the axial direction. External transverse excitation of the spans comes from polygonal action, and is treated through kinematic forcing at the moving string boundaries. Perturbation analysis of the model is carried out using the method of multiple scales. Results show a multitude of internal and external resonance conditions, and some examples are presented of both decoupled and coupled motion. Together, the kinematic and dynamic model are aimed toward providing a framework for conducting and understanding both numerical, and experimental investigations of roller chain drive dynamics.

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