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AN ANALYSIS OF RESPONSE OF AN EPICYCLIC GEAR TRAIN SOLUTION WITH TANDEM BICYCLING

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Abstract

This paper reports a unification of kinematic and force-based methods for the design and analysis of planetary gear trains along with a discussion of potential applications in tandem biking. Specifically, this thesis will provide a simple solution technique for the general case of a two-degree of freedom (2DOF) planetary gear train along with new graphical design aids. It will also address the use of epicyclic gear trains as a power coupling in a tandem bike. Planetary gear trains are given a clear treatment with regard to the pure kinematics of the system that includes the torques present in the system. By treating both the kinematics and torque balance of the most general case, this thesis attempts to fill a void in the current literature. After developing the solution to the general two-degree of freedom case using the Willis formula, a force analysis will be performed using the conservation of energy principle assuming zero losses. After fully developing a satisfactory solution technique and design tools, these will be applied to the problem of coupling the power provided by the riders of a tandem bicycle. The drive of this project, rather than the design of a gear train for a specific purpose, is to create a concise design method that will allow development of planetary gear trains for any number of possible applications. By dealing with the planetary in the most general case possible, this project explores the reasons for the failure of the HPV team's design as well as allowing engineers to define the kinematic relationships between the three branches of the planetary gear train without first selecting a physical arrangement of gears.

Keywords: epicyclic, planetary, gear train, kinematics, design.