A model of chain drive efficiency dedicated to high performance track cycling

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This study presents a roller chain transmission model designed to take into account the specific constraints of high-performance applications, particularly in the field of track cycling. A wide range of possible loss mechanisms is considered to obtain accurate efficiency predictions. In the meantime, an experimental study is conducted to enrich the model.
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1. Introduction

Despite being used since more than a hundred years, roller chain mechanisms are still very similar to the one invented by Hans Renold in the early 19th century. Since then, not a lot of studies about the efficiency of such mechanisms have been published [1] and even less deals with the use of chain drive dedicated to bicycle [2]. As science always push forward human performances on bicycle, especially in track cycling, the need for a wide study dedicated to this field has grown. Indeed, in high performance track cycling, nothing can be left to chance since the difference between victory or defeat can now be decided by some milliseconds.

In chain drive mechanism, losses are mostly due to sliding friction between constitutive parts. This sliding mainly occurs in joints during chain wrapping around the sprockets. However, depending on the operating conditions, other chain components can rub on each other and then increase losses.
To predict as accurately as possible, the efficiency of a given track cycling transmission configuration, the present study proposed an extended model of chain drive efficiency. This model is built considering experimental observations carried out simultaneously.

2. Methods

2.1. Theorical study

Since the model has to provide a high level of accuracy, phenomena with a low influence that are generally neglected, such as vibrations [1], have to be taken into account. Thus, to build this model, all possible sources of friction have been listed and characterized. They were then merged into one single simulation.

2.2. Experimental study

At the same time, an experimental study is conducted on a test bench designed for this purpose. This study provides indications for the theorical approach as well as precise values of physical coefficients (e.g. friction coefficient) allowing to create a model that is as precise as possible.

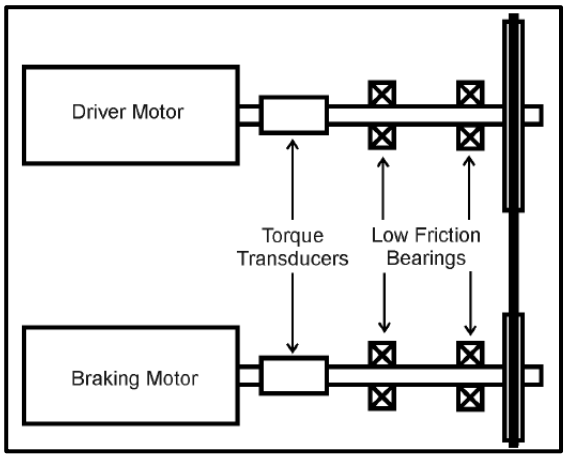

Figure 1: Drawing of a test bench measuring chain drive efficiency [1].

3. Discussion

In the search for transmission optimization, most loss mechanisms are interdependent. For example, the use of bigger sprockets (i.e. chainring) tends to increase the efficiency by decreasing the articulation angle [2] but also raise the weight of the mechanism which indeed decreases efficiency. Compromises must therefore be made between several phenomena in order to design the most efficient configuration. By considering a wide range of loss mechanisms, this study allows to draw such compromises.

4. References

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