Design and Simulation of Rail Vehicles
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As stated in its title, in 10 chapters this relatively concise book attempts to cover all aspects related to the design and simulation of railway vehicles. The authors are six professors and railway professionals associated with the Centre for Railway Engineering at the Central Queensland University (CQU) in Australia. The Centre was involved in a number of valuable research projects on railway engineering including rail noise studies that are not discussed this book. The book is an ambitious undertaking and it appears that the authors were given strict page limits, which explains why the discussions of an extensive variety of simulation and design topics fit into a 323-page book. This book is at least indirectly relevant for anyone with projects related to rail noise. However, I never noticed noise and vibration being mentioned.

An example of one of my projects where this book would have been useful is a multi-disciplinary study performed several years ago to understand why a new light rail system was louder than expected. In some locations, the noise levels were up to 10 decibels greater than expected, which resulted in some very uncomfortable community meetings. The study included noise measurements, rail roughness measurements, computer modeling of the vehicle/track interaction using VAMPIRE (one of the tools discussed in this book), tribology and approaches to rail grinding. There were a number of discussions between professionals from diverse fields about how to best approach the various issues and how to combine all the different pieces of the study into concise recommendations. The other professionals knew as much about noise as I know about tribology. If this book had been available, it would have helped me in these discussions because I would have had a better idea of the scope and limitations of the tools (such as VAMPIRE) that others were using.

The first three chapters provide a brief introduction and discuss the general design of unpowered vehicles and locomotives. This introductory material outlines the evolution of rail vehicles going back to 1814 when George Stephenson built the first locomotive that used friction forces between a smooth flanged wheels and smooth rail for the tractive effort. Also, apparently Stephenson was the one who selected a rail gauge of 4 ft 8½ inches, which is the standard gauge in Western Europe and North America. I did a quick Google search, and it appears to be an urban myth that Stephenson selected 4 ft 8½ inches because that was the width of Roman chariots. Apparently chariots were obsolete well before the Roman Empire formed and extended to England.

Chapters 4 through 9 cover General Modeling Techniques, Multibody Dynamics, Long Train Dynamics, Rail Vehicle-Track Interaction Dynamics, Co-Simulation and Its Application and Advanced Simulation Methodologies. Probably each chapter could be a separate book. For readers who want to dig deeper into any of the topics, most chapters provide an extensive list of references.

One factor that I found interesting is just how many aspects of railway vehicles need to be analyzed. A short list of topics is as follows:

- Longitudinal dynamics, which relates to how a 10,000 ft long freight train negotiates curves without derailing
- Vehicle dynamics, which includes the interaction between a vehicle and the track. Some of the modeling programs discussed are NUCARS, GENSYS, VAMPIRE, ADAMS/VI-RAIL, and others. Each seems to have different strengths and weaknesses.
- Modeling of the wheel/rail contact patch, which relates to creation of surface cracks and actually relates to wheel/rail noise
- Air brake systems on freight trains where it will take several seconds for the pneumatic signal from the front of the train to reach the rear of the train
- The effects of slack in the coupling system when trains accelerate and brake. An interesting factoid is that without some slack in the coupling systems, it would be extremely difficult for a long freight train to start up from a stop.

The bottom line is that this is a specialized book that is only relevant to acoustical professionals when they have projects involving detailed evaluations of railway noise and vibration. However, if you are involved with such a project, this is a good book to have on hand for reference. It also might be on interest to some hardcore, very technical rail fans.

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