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On the decoupling of electromechanical systems

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Abstract: Electromechanical systems are a type of coupled systems. The mutual influence between electromagnetic and mechanical subsystems characterizes coupling. Each subsystem affects the behavior of the other. Typically, the dynamics of an electromechanical system is expressed by an initial value problem (IVP) that comprises a set of coupled differential equations involving electrical and mechanical variables. This paper discusses a hypothesis found in the some references of the literature that deals with electromechanical systems that simplifies the dynamics greatly. Apparently, it is a nice hypothesis and reduces the number of equations in the IVP that gives the dynamics. The hypothesis originates a reduced system. However, the hypothesis contradicts itself and changes the dynamics. The objective of this paper is to show that the hypothesis leads to wrong results. The reduced system does not represent the complete system and moreover, decouples the electromagnetic and mechanical subsystems. The dynamics of the electromagnetic part is ignored. To highlight these problems, we analyze the effects of the hypothesis for a simple electromechanical system, a motor-cart system, with parametric excitation. This hypothesis is part of a group of errors that are found in the literature that deals with electromechanical systems (called as non-ideal systems or system with a limited power supply) at least since 1943. All errors somehow decouples an electromechanical system, transforming it into a purely mechanical system. In this work we discuss one of these errors.

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