A Critical Overview of Several Methods to Handle the Problem of Constraints Violation in Forward Multibody Dynamics

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ABSTRACT

It is known that the dynamic equations of motion for constrained multibody systems are frequently formulated using the Newton-Euler's approach, which is augmented with the acceleration constraint equations. This formulation results in the establishment of a mixed set of partial differential and algebraic equations, which are solved in order to predict the dynamic behavior of general multibody systems [1]. The classical resolution of the equations of motion is highly prone to constraints violation because the position and velocity constraint equations are not fulfilled [2]. Thus, the present study aims at comparing among the different models to handle the constraints violation in forward dynamics. In the sequel of this process, the standard method based on the Lagrange multipliers technique, Baumgarte stabilization method, the penalty approach, the augmented Lagrangian formulation and coordinate partitioning method have been carefully revisited [3]. Results for several multibody systems are presented and utilized to discuss the assumptions and procedures associated with each formulation. All of the presented models show different computational efficiency and accuracy when simulating the dynamic behavior of the mechanical system of general type. Therefore, it is important to understand which model can be more suitable for a particular application. Since the numerical errors responsible for the constraints violation can be related to the integration algorithm adopted, it becomes crucial to investigate also the influence of the integrator scheme together with time step on the computational accuracy and efficiency in the context of the present study.

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