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Guest Editorial

Special Issue on Computational Multibody Dynamics

This issue of the *Journal of Computational and Nonlinear Dynamics* presents a snapshot of the state-of-the-art in Computational Multibody Dynamics (CMD). Since any attempt at approximating the time evolution of dynamical systems begins with the question of finding robust and efficient numerical integration methods, this special issue opens with several contributions that concentrate on this topic. Specifically, the first four papers cover both analytical and practical aspects related to numerical time integration, for smooth and non-smooth dynamics, for rigid and flexible body systems. Flexible body dynamics is further discussed in two contributions. The first outlines a procedure to reduce the computational burden that flexibility typically places on the numerical solution; the second illustrates how recent CMD advances are leveraged in the context of a challenging biomechanics application. One of the recurrent themes of the research effort within the CMD community pertains to the focus on system-level engineering applications. This usually requires leaving behind the convenience of dealing with simple systems, concentrating instead on complex problems such as active rotorcraft control, quantifying the uncertainty in the aerodynamic loads acting on ground vehicles, or designing an optimal set of experiments for parameter estimation for accurate vehicle dynamics simulation.

Moving beyond the breath aspect discussed above, an attempt was made to illustrate the fact that the CMD community is robust and dynamic. Several contributions concentrate on topics in well established areas that provide the core competencies of this community: numerical integration, flexible body dynamics, nonlinear control, and frictional contact dynamics. Other contributions concentrate on application fields that, until recently, fell outside the scope of this community either because of a lack of dialogue with colleagues from other disciplines, or because the available analytical and computational tools were not mature enough. Uncertainty quantification, system decomposition for distributed computing, biomechanics, and molecular dynamics provide new areas of engineering and science where the CMD community can make fruitful contributions, as illustrated by several papers of this issue.

Today, Computational Multibody Dynamics addresses real world, system-level applications leading to better engineering designs within a shorter development cycle and at a reduced cost. Looking forward, there are many reasons to be optimistic. Members of the community are making steady analytical advances that leverage ever increasing computational power. The emergence of commodity high performance computing, such as GPU computing, for instance, will surely be met in our community by an enthusiastic group of individuals ready to push the boundaries of Computational Multibody Dynamics to understand through simulation the dynamics of complex systems be it at the atomic (molecular dynamics), meso (granular dynamics), or macro (vehicle dynamics) scales.

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