MODELING OF UNILATERAL CONTACT CONDITIONS WITH APPLICATION TO AEROSPACE SYSTEMS

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This paper describes an analysis procedure for the modeling of backlash, freeplay and friction in flexible multibody systems. The problem is formulated within the framework of finite element based multibody dynamics [1] that allows the analysis of complex, flexible systems of arbitrary topology. Tools developed for the modeling of contacts in multibody systems [2,3] are directly applied to the simulation of joints with backlash. Furthermore, the incorporation of the effects of friction in joint elements is discussed. The procedures allow to incorporate all these non-standard effects in the dynamic simulation of flexible mechanisms.

The versatility and generality of the approach is demonstrated with the help of three complex problems dealing with the modeling of various aerospace systems. The first example deals with the effect of freeplay in a wing-aileron system. This model could be used to evaluate the robustness of a control law designed for a nominal system without freeplay. The second example demonstrated the use of backlash elements for modeling flap and droop stops in articulated rotors. The resulting transient loads in the rotor control linkages are also computed, and could be higher than those encountered during nominal operation. The last example illustrated the modeling of friction effects in revolute joints. This is particularly relevant in space applications such as the deployment of antennas.

All these examples highlight the importance of general, flexible and robust numerical procedures that are capable of bridging the modeling capabilities of classical finite element methods with those of multibody formulation, with the goal of providing modern design tools with the widest possible spectrum of applicability. Finite element based multibody formulations extend the capabilities of conventional finite element methods to the analysis of flexible mechanism presenting arbitrary topologies.

References

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