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INFLUENCE OF THE BAUMGARTE PARAMETERS ON THE DYNAMIC RESPONSE OF MULTIBODY MECHANICAL SYSTEMS

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Abstract. The main purpose of the work presented in this paper is to perform numerical simulations of multibody mechanical systems with particular emphasis on the influence of the stabilization coefficients on the constraints violation. The formulation of motion's equations of multi-rigid body systems is also described. The generalized coordinates are the centroidal Cartesian coordinates, that is, two translational and one rotational variables for each rigid body, corresponding to the three degrees of freedom, being the system configuration is restrained by constraint equations. The dynamic formulation uses the Newton-Euler's equations of motion, which are augmented with the constraint equations that lead to a system of differential algebraic equations. The constraint violation stabilization method, based on the Baumgarte's approach, is also presented and discussed in this work. Results for a four bar mechanism are presented and used to discuss the assumptions and procedures adopted.

Keywords. Baumgarte parameters, multibody dynamics, constraints violation

1 Introduction

The dynamic analysis of multibody systems, made of interconnected bodies that undergo large displacements and rotations, is a research area with applications in a broad variety of engineering fields that has been deserved relevant attention over the last few decades [1-5]. Many multibody computational programs capable of automatic generation and integration of the differential equations of motion have been developed, such as DAP [2], DADS [6], ADAMS [7], COMPAMM [8] or SIMPACK [9]. The various formulations of multibody systems used in these programs differ in the principle used, e.g. principle of virtual work, principle of virtual power, Newton-Euler's approach, types of coordinates adopted, e.g. Cartesian coordinates, Lagrangian coordinates, and the method selected for handling constraints in systems characterized by closed loop topology, e.g. Coordinate Partitioning Method, Augmented Lagrange Formulation [2,10]. The solution of constrained multibody systems can be obtained using the Lagrange's multipliers technique