Analysis of dry impacts on the basis of reduced elastic bodies

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For mechanical systems which undergo large nonlinear working motions and small linear deformations the elastic multibody systems approach is often selected [1]. For modeling each flexible body, the multibody system is cut free and the elastic displacement field of a single body is approximated by the Ritz approach together with the finite element method to obtain the equation of motion of each body. The reduction of the large number of elastic degrees of freedom is fundamental for the use of flexible structures in the multibody simulation. The reduction by linear model reduction allows a more efficient simulation with sufficient accuracy. A special challenge is represented by simulations with impacts. To get accurate results for elastic multibody simulations with impacts, both the global elastic deformation and the local deformation at the impact area have to be approximated very well. In [2] it is shown that many modal shape functions are necessary for this. The use of alternative procedures in reducing the elastic body for impact simulations is untested and of great interest. The issue of impacts in association with model reduction is that there are many points on which forces may act, which means that one gets an input matrix containing several columns. Additionally, the output matrix contains also many rows, since it is necessary to observe the nodes at which the body is in contact. The aim of the contribution is to study the model reduction of flexible bodies in a pure impact problem with the background of many input and output variables. Here a comparison of non-modal reduction methods, [3], with modal methods is performed. The high number of inputs and outputs is accompanied by growing difficulties in the model order reduction process. Depending on the reduction method, a methodological and qualitative input/output dependency can be shown. As an example, using the Craig-Bampton reduction technique, the minimum reduction size is determined by the number of attachment points and inputs, respectively. Moreover, the establishment of criteria for assessing the quality of the reduced body with respect to the approximation quality of the impact is essential.

References:

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