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Efficient Impact Analysis Using Reduced Flexible Multibody Systems And Contact Submodels

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Impacts yield local deformations in the contact area and as a result high frequency vibration in the impacting bodies may occur. Investigating the system behavior during and after impact, the correct representation of local stresses in the contact area as well as the global vibration phenomena and rigid body motion are of interest. For an efficient impact analysis considering the local and global deformation behavior, reduced flexible multibody systems combined with a contact model can be used. However, using a moderate number of eigenmodes in the flexible multibody system, it is not possible to capture the local deformation of the contact area accurately. Hence, to obtain a better local approximation, the reduction basis is extended by static shape functions. However, these static shape functions introduce artificial frequencies of very high magnitude. Due to these high frequencies, the numerical stiffness increases which leads to very high computation times.

Therefore, this work presents two approaches for an efficient contact simulation in reduced flexible multibody systems using static shape functions. In both approaches, the flexible parts in the equations of motion of the flexible multibody system are divided in low and high frequency parts, see [1]. The low frequency parts represent the global motion including vibration phenomena, whereas the high frequency parts only represent the local deformations. Those high frequency parts, introduced by the static shape functions, are only required for capturing the local deformations and have no effect on the actual vibrations in the bodies. In the first approach, modal damping is used to reduce the numerical stiffness by damping those high frequencies. In a second approach, a quasi-static contact submodel is presented. In this approach, the dynamics of the high frequency parts are neglected in the dynamic simulation. Besides capturing local deformations, this work focuses also on the recovery of stresses in the contact area from the reduced model using stress modes. The results using this approaches will be compared with nonlinear FE simulations showing high accuracy and substantial reduction of computation time.

REFERENCES

[1] S. Tschigg and R. Seifried. Efficient Evaluation of Local and Global Deformations in Impact Simulations in Reduced Flexible Multibody Systems based on a Quasi-Static Contact Submodel. *Proceedings of the ECCOMAS Thematic Conference Multibody Dynamics 2017*, 315–325, 2017.