Seminar über Fragen der Mechanik

zu folgendem Vortrag wird herzlich eingeladen

Montag, 04.02.2013, 14:15 Uhr, Egerlandstr. 5, Raum 0.044

Mortar contact in the FEM package CalculiX

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Solving nonlinear contact problems in the FEM framework is still a challenging task from both the mathematically and the engineering point of view. The most popular methods to enforce the contact condition in the context of nonconforming meshes are the penalty method as a node-to-segment approach and the Lagrange multiplier method as a segment-to-segment approach or a combination of both. In the penalty framework, a spring between a slave node and a master surface is generated modelling the contact traction $t_c = a_n\, g_n(u)\, n$, if the non-penetration condition is violated. Thus the contact forces do not enter as an extra variable in the system. In case of hard contact with $a_n \rightarrow \infty$ this leads to an ill-conditioned system matrix. This can be avoided using Lagrange multipliers as an extra variable modelling the contact traction. But here one has to solve a linear system for the displacements and the contact traction in every Newton-Raphson iteration.

Among the Lagrange multiplier methods the dual mortar-method presented here has become of great interest [1,2,3,4], since it enforces the non-penetration condition in a weak sense without increasing the system size. Due to biorthogonality of the dual basis functions, the dual Lagrange multipliers can be condensed from the global system of equations. Combining the dual mortar method with a semi-smooth Newton method, which interprets the contact conditions as a semi-smooth nonlinear function, one gets a powerful tool for contact problems since all nonlinearities of the system (material and contact conditions) can be considered within the same iteration loop.

[1] B.I. Wohlmuth. A mortar finite element method using dual spaces for the Lagrange multiplier. SIAM J. Numer. Anal., 38:989-1012, 1998.

[2] S. Hüeber. Discretization techniques and efficient algorithms for contact problems. PhD thesis, Universität Stuttgart, 2008.

[3] C. Hager. Robust numerical algorithms for dynamic frictional contact problems with different time and space scales. PhD thesis, Universität Stuttgart, 2010.

[4] A. Popp, M. Gitterle, M.W. Gee, W.A. Wall. A dual mortar approach for 3d finite deformation contact with consistent linearization. Int. J. Num. Meth. Eng. 83:1428-1465, 2010.

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