SOPHIE LÉGER, Université Laval

An updated Lagrangian method for very large deformation problems

The use of the finite element method is quite widespread for the analysis of large deformation problems, notably for the calculation of tire deformation. In this case and in many others, a good numerical method is essential. Industrial partners expect accurate, efficient and robust methods, and all of this preferably at a low computational cost.

When using a Lagrangian point of view in the finite element method for the resolution of large deformation problems, the mesh elements can become severely distorted over time. This can lead to numerical instabilities and slow convergence. To avoid this problem, frequent remeshing of the domain during the computation becomes necessary in order to optimize the quality of the mesh and thus improve convergence. In an updated Lagrangian framework, the deformation gradient tensor, which is key for the calculation, has to be transfered from the old mesh to the new mesh after each remeshing step. In this presentation, we will compare different transfer techniques and show which one seems to be more efficient and give the best results.

Numerical continuation methods have proved to be very powerful tools when dealing with very nonlinear problems. When combining both a good remeshing algorithm and a good transfer method for the deformation gradient tensor with the Moore-Penrose continuation method, we will show that very large levels of deformation can be attained and that the combination of all these tools leads to a very stable and efficient updated Lagrangian algorithm.