Modélisation mécanique avec FreeFEM (Mechanical modeling with FreeFEM)

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The mechanical contact between two bodies is a difficult problem in solid mechanics, indeed the contact area is unknown. Contact problems can be encountered in many industrial applications, so the development of a simple and robust algorithm to solve these problems seems very interesting.

In the first part of this work, we will present a simple algorithm, developed using FreeFEM [1], treating Signorini's problem (contact between a body and a rigid foundation). Linear elasticity is assumed for simplicity. The contact problem is formulated into a constrained minimization one, in addition the Interior point method is used in order to solve the constrained minimization problem by calling the Interior point optimizer (IPOPT) [4].

In the second part, we will consider other phenomena in addition to contact problems, such as fluid-structure interaction or thermal expansion. This work is based on [2, 3] where the contact is considered in a general manner.

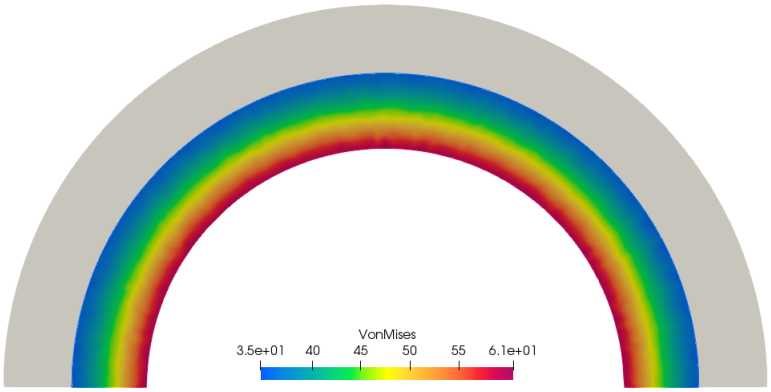

FIGURE 1 – Von Mises stress for Signorini's problem

[1] F. Hecht. *New development in freefem++*. J. Numer. Math., **20(3-4)**, 251–265, 2012.

[2] H. Houssein. *Finite element modeling of mechanical contact problems for industrial applications*. Ph.D. thesis, Sorbonne Université, 2022.

[3] H. Houssein, S. Garnotel, F. Hecht. *A symmetric algorithm for solving mechanical contact problems using freefem*. To appear in Computational Methods in Applied Sciences, 2022.

[4] A. Wächter, L. T. Biegler. *On the implementation of an interior-point filter line-search algorithm for large-scale nonlinear programming*. Mathematical programming, **106(1)**, 25–57, 2006.

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