UME Seminar

Multiple solutions to contact problems with Coulomb's law of friction

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Amphi 104 - Pôle Mécanique
Seminar webpage link

Abstract

Contact and friction appear in many engineering systems and the Coulomb law of friction is popular and widely used to model contact between two solids [1]. However, the mechanical problem of two solids in contact with friction is non-linear and difficult to solve. Indeed, the friction's cone and non-interpenetration conditions are written as inequalities to be verified in addition to standard boundary conditions (Neumann, Dirichlet), equilibrium of moments and constitutive relation. In addition, mathematical results on the uniqueness of solution to the discretized problem are limited to small friction coefficient[2]. This is due to the fact that Coulomb's law cannot be derived from a potential but only from a bi-potential.[3] Many numerical strategies have been proposed for the last decades to solve this problem after discretization (finite element discretization for the solids and quasi-static evolution) but none of them is at the same time robust, precise and not too expensive in terms of computational cost [4]. In this presentation, we consider two academic cases of contact between two solids exhibiting multiple solutions. We study the influence of the friction coefficient, the numerical methods and their parameters on the solution(s) obtained at convergence [5].
[1] P. Wriggers. Computational Contact Mechanics, 2nd ed., Springer, 2006.
[2] Christof Eck, Jiri Jarusek, and Miroslav Krbec (2005). Unilateral contact problems : variational methods and existence theorems.
[3] De Saxcé, G. (2018). Variational and Numerical Methods Based on the Bipotential and Application to the Frictional Contact. I
[4] Acary, V., Brémond, M., & Huber, O. (2018). On Solving Contact Problems with Coulomb Friction : Formulations and Numerical Comparisons.
[5] Rey, V. (2026). On the influence of resolution algorithm's parameters on the converged solution for a Coulomb friction contact problem exhibiting multiple solutions.

About the speaker

Valentine Rey earned her PhD in 2015 on domain decomposition and error estimation, followed by a postdoctoral fellowship at EPFL (2015–2017) working on random rough surface contact.
Since 2017, she has been an Associate Professor at Nantes Université (GeM), where she is currently the head of the computational mechanics research unit. Her research focuses on structural reliability, fatigue in offshore structures, and Coulomb friction contact—the subject of today's talk. She also served on the CSMA Juniors board from 2020 to 2024.

