MUR
Dipartimento
di Eccellenza
2018-2022
2023-2027

Research project

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Title: Finite-strains adhesive and frictional contact mechanics

Description:

From Hertz's pioneering work in 1882 to recent advancements in the field, contact mechanics has traditionally relied on the strong assumptions of linear elasticity. However, experiments involving materials that undergo large deformations, such as rubbers and elastomers, are hard to be described within this framework based on small strain and displacement, especially when frictional slip occurs [1-3]. In such cases, it has been proved that move beyond linear elasticity is essential to account for geometric and material nonlinearity [4]. Despite efforts to develop numerical tools capable of incorporating these features in contact problems [5], our understanding of their actual impact remains limited.

Recent studies have shown that these effects might significantly alter the systems response [6-8], even in a counterintuitive manner (e.g., contact area variation, friction enhancement, hysteresis, etc.); however, the investigation is case-sensitive and still focus on very simple geometries (Hertzian, sinusoidal, peeling), eventually being of limited practical interest.

The objective of this project is to develop a numerical tool to investigate the role of finite elasticity on the contact response of real (rough) interfaces, eventually accounting for fundamental phenomena such as friction and adhesion. In the framework of innovative FEM calculations simplified to deal with multi-asperity conditions, finite range adhesion (as well as infinitely short range) and different local friction models will be implemented.

The expected outcomes will allow for a critical understanding of the interfacial response in real applications governed by system nonlinearity, thus well beyond the current state of the art relying on linear theory.

References:

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[6] Scaraggi M, Comingio D, Al-Qudsi A, De Lorenzis L. The influence of geometrical and rheological non-linearity on the calculation of rubber friction. Tribol Int 2016;101:402–13.

[7] Begley MR, Collino RR, Israelachvili JN, McMeeking RM. Peeling of a tape with large deformations and frictional sliding. J Mech Phys Solids 2013;61(5):1265–79. http://dx.doi.org/10.1016/j.jmps.2012.09.014.

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Candidates should provide detailed CV

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