The 8th European Congress on Computational Methods in Applied Sciences and Engineering
ECCOMAS Congress 2022
5-9 June 2022, Oslo, Norway

A dual-scale method to address plastic deformation in contact problems

Mohammad Aramfard[*1], Yaswanth Murugesan[1], Francesc Pérez-Ràfols[1] and Lucia Nicola[1,2]

[1] Department of Industrial Engineering, University of Padova, I-35131 Padova, Italy
[2] Department of Materials Engineering, Delft University of Technology, 2628 CD Delft, The Netherlands
[*] Corresponding author: mohammad.aramfard@phd.unipd.it

Keywords: *Multiscale Modeling, Contact Mechanics, Friction*

Various methods have been developed to study the contact response of solids with self-affine rough surfaces. FFT-based boundary element methods have shown to be the most computational-efficient, outperforming the finite element method. These techniques allow one to mesh the surfaces with a very high density of discretization points, thus spanning all wavelengths required. In this work we intend to use a boundary element method of this type [1] coupled concurrently to an atomistic domain to study contact between metallic surfaces and their plastic deformation through dislocation nucleation and glide [2]. The atomistic domain is linked through a buffer region to a linear elastic isotropic domain. Loading of the flat continuum domain occurs through the tractions imposed by the atomistic domain. The continuum domain loads subsequently the atomistic domain while displacing the buffer. The equilibrium static solution is obtained iteratively through energy minimization of the atomistic domain and the deformation of the continuum domain is found by superposition of the elastic solution of the dislocations and their images. The method is first validated using full atomistic simulations for nanoscale crystals and then used to study the contact behavior of microscale rough solids.

REFERENCES

[1] S.P. Venugopalan, M.H. Müser and L. Nicola, Green's function molecular dynamics meets discrete dislocation plasticity. *MSMSE*, Vol. **25**, pp. 065018, 2017.

[2] E. Van der Giessen, A. Needleman, Discrete dislocation plasticity: a simple planar model. *MSMSE*, Vol. **3**, pp. 689, 1995.