9th International Conference on Discrete Element Methods (DEM9)
September 17 - 21, 2023, Erlangen, Germany

Influence of contact topology on the fracture behaviour of particles

Bin Zhang and Sadegh Nadimi

School of Engineering, Newcastle University, UK

(b.zhang48@newcastle.ac.uk, sadegh.nadimi-shahraki@newcastle.ac.uk)

The initial area of the sphere-to-sphere contact is invariably a point and evolves to a circle under compression. In natural particulate materials, however, the contact topologies arising from the irregular-shape particles make their modelling non-trivial [1]. In this study, we present how the contact topology affects material fragmentation using a numerical approach. This approach is an extension of micro finite element method proposed in [1] incorporating cohesive interface elements to represent crack initiation and propagation [2]. The irregular particles are generated from micro-CT images and meshed using an in-house code. The mesh is enriched by adding zero thickness cohesive interface elements to enable random crack initiation and propagation. We visualise the crack initiation and propagation within the particle and quantify that the contact topology as it changes rapidly when the normal load is altered. Thus, for the same loading stage, the associated stress varies for various contact topologies and contributes to different fracture patterns. More flat contact topologies led to stress concentration at the central point, avoiding failures due to edge crushing and initial chipping. This study aims to establish a relationship between fracture behaviour and contact topology. It provides a new insight on predicting how particle breaks under complex contacts to inform multi-particle simulations.

Keywords: Fracture behaviour; Contact topology; Micro finite element method

REFERENCES

[1] Nadimi, S., & Fonseca, J. (2018). A micro finite-element model for soil behaviour. *Géotechnique*, **68**(4), 290-302.

[2] Zhang, B., Nadimi, S., Eissa, A., & Rouainia, M. (2023). Modelling fracturing process using cohesive interface elements: theoretical verification and experimental validation. *Construction and Building Materials*, **365**, 130132.