Comparison of two DEM strategies for modelling cortical meshes

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ABSTRACT

Metallic cortical meshes are currently being used in many engineering applications, especially for the mitigation of the rockfall hazard along slopes. These structures are constituted by ordered intersections of steel wires and cables having a ductile mechanical behaviour. The complex geometries and pattern of the wires, the different material properties, and the existence of non-trivial boundary conditions make these structures difficult to be modelled as simple continuum membranes. Moreover, their high deformability and the chance of local ruptures in the mesh make the numerical modelling of such structures very challenging. One of the approaches for efficiently simulating these structures is the discrete element method (DEM) which is particularly suited to treat high deformable problems including discontinuities and complex failure modes.

This work shows a comparison of two different discrete element modelling strategies for simulation of a double-twisted hexagonal wire mesh: the first one represents the wire mesh as a collection of interactions; the second approach instead describes each wire of the mesh as a collection of interconnected cylinder elements. In the first model, each node of the mesh is represented by a fictitious particle, while the wires are substituted by long-range tensile interaction forces [1]. These attractive forces have been implemented in the model on the basis of results of single wire and double-twist tensile tests [2]. In the second model instead, interconnected deformable cylinders are used to represent single and double-twisted wires [3]. Differently to the previous model, these solid bodies have a physical shape, equal to the real one, and in addition to tensile forces they can also respond to bending and twisting moments. Another major difference is that the cylinders present the actual geometry more accurately. In both cases, the mechanical response of the wires are estimated and calibrated on the basis of laboratory results.

The two models will be assembled and tested with reference to a punch test on a 3 m x 3 m mesh panel: the force-displacement curve and the shape of the deformed mesh will be compared and discussed. Also the differences in computational cost and their potential for future applications will be presented.

REFERENCES

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