Numerical modelling of fiber reinforced jammed granular columns

Pavel S. Iliev[†,*], Falk K. Wittel[†] and Hans J. Herrmann[†]

[†] Computational Physics for Engineering Materials, IfB, ETH Zurich
Stefano-Franscini-Platz 3, CH-8093 Zurich, Switzerland
e-mail: ilievp@ethz.ch, web page: http://comphys.ethz.ch

ABSTRACT

Fiber reinforced granular materials, such as reinforced sands and soils, are widely used in geotechnical applications and their mechanical properties have been studied extensively by numerical and experimental means. Opposite to reinforced soils, we intentionally place the reinforcing string along an apriori determined path. This way the material becomes anisotropic and is able to self-confine itself in a way that granular columns become feasible as demonstrated in [1]. In this work we present a DEM based numerical study of the stability and the mechanical behaviour of wire reinforced unconfined granular columns. The particles are convex, arbitrary shaped polyhedra and the wire is modelled as a chain of lumped masses connected by spring elements as shown in Fig. 1. Our simulations incorporate a combination of the Non-Smooth Contact Dynamics method for the particle-particle interactions and the Smooth Particle method for the wire-wire and wire-particle interactions. We investigate the influence of particle shapes and sizes, friction coefficients and wire stiffness on the stability of columns under uniaxial loading. We study the force-displacement behaviour of the system and analyse the strain energy distribution along the wire, the statistics of the force networks as well as local load redistribution mechanisms to shed light into the mechanics of fiber reinforced jammed granular columns.

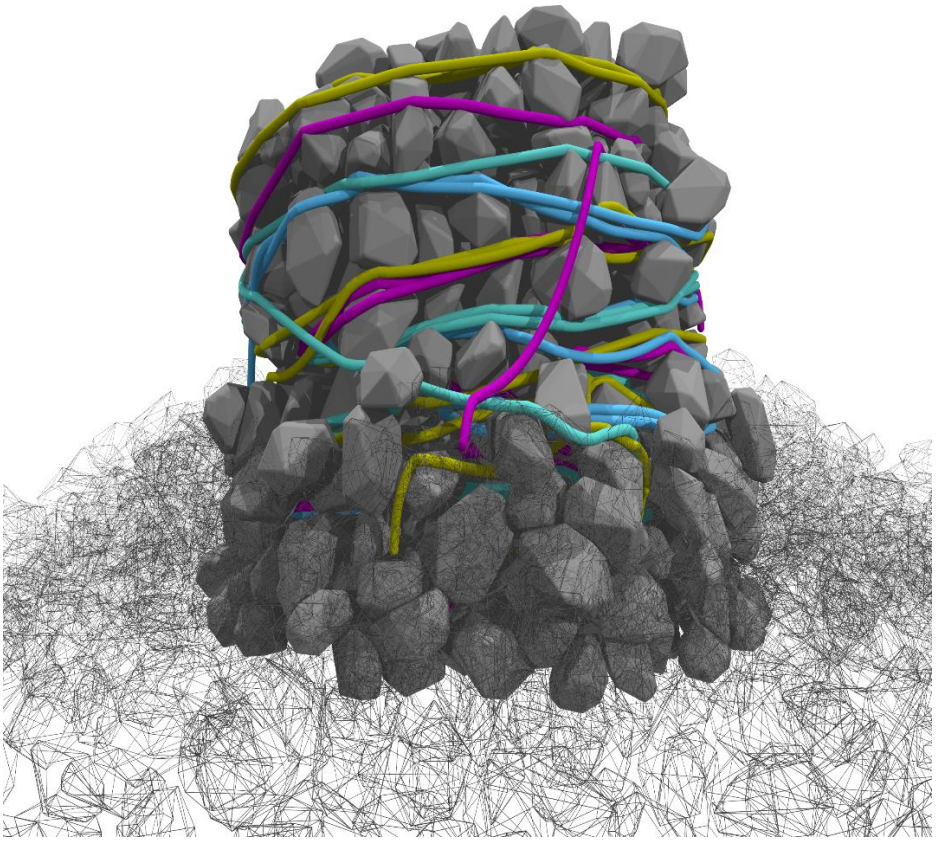

Fig. 1 Simulation of a fiber reinforced granular column. Colors on the wire represent different segments and noncontributing particles are only outlined.

REFERENCES

[1] Jamming-Based Aleatory Architectures, Granular Matter, 18:23 – 18:29 (2016)