A reappraisal of the concept of the strong/weak force networks for granular materials

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ABSTRACT

The concept of the strong/weak force networks for granular materials has been proposed by Radjai et al [2]. The weak (strong) contact network consists of the contacts where the normal force is smaller (larger) than the average normal force. Based on results of particle simulations, Radjai et al [2] have shown that features of the strong/weak force networks are:

1. the major principal direction of the fabric tensors corresponding to the weak and the strong contact networks is in the minor and major principal stress direction, respectively.
2. the weak network predominantly carries to isotropic stress, while the strong network carries the deviator stress.

Here the concept of the strong/weak force networks is reappraised by noting that the probability density function for the contact force will depend on the contact orientation. Besides the average *over-all-contacts* force as employed by Radjai et al [2], an orientation-dependent average force can be determined. The features of the strong/weak contact networks listed above will be analysed here from the perspective that statistics of contact forces are dependent on contact orientation.

In biaxial tests the principal directions of the stress and fabric tensors will coincide. The forces will be larger in the principal stress direction. Hence, it follows that weak contacts where the contact force is smaller than a (some fraction of) the average *over-all-contacts* force will be found predominantly in the direction of the minor principal stress. Therefore, the principal direction of the fabric tensor corresponding to weak (strong) contacts will be in the direction of the minor (major) principle stress, respectively.

The shear stress is mainly determined by contacts in the major principal stress direction. The mean stress is determined by all contacts. Hence, it follows that the shear strength, the ratio between shear stress and mean stress, is mainly determined by the contacts aligned with the major principal stress direction. This means that the shear strength is mainly carried by the strong contact network.

In this reappraisal the key point is that statistics of the contact force distribution are anisotropic. From this characteristic, the listed specific features of the weak/strong force networks are readily explained.

This viewpoint that the probability density function for contact force is dependent upon the contact orientation is made more rigorous by selecting a simplified form for the probability density function for the contact forces and analysing the characteristics strong/weak network in more detail, following the analysis by Kruyt [1].

REFERENCES

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