Determination of shear zone structure and structural anisotropy within sheared bulk solids using X-ray tomography

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ABSTRACT

Simulating motion and structure of a bulk of fine particles under external stress by discrete element and similar methods is still difficult and needs proper calibration and validation. By determining the particle motion on particle level using X-ray tomography instead of or besides using macroscopic measures like global bulk density or shear stress new simulation models can be derived, existing models can be calibrated and simulation results can be validated.

For this purpose a special micro-shear tester was developed which can be integrated into a X-ray tomography device in order to visualize the motion of individual particles under defined consolidation and/or shear of small bulk volumes in the range of a few μl^{1}. The information of particle motion, and hence, of particle position in space and time allow for a detailed analyses in the bulk structure and the particle arrangement. However, this data is also capable to improve simulation behaviour due to model calibration processes. In conformity to simulations, determining density distributions in radial and axial direction reveals the dimension of anisotropic behaviour. Moreover, a geometric characterization of the shear zone was achieved by localizing the shear band within the shear zone. On the same way, the determination of further shear band features such as thickness and homogeneity could also be derived from the tomography image data.

REFERENCES

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