

Electronic Supplementary Information for: Measuring and upscaling micromechanical interactions in a cohesive granular material

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I. SUPPLEMENTAL MOVIE CAPTIONS

Movie S1 (*S1_tension_test.avi*)

Movie of a micromechanical test in the normal configuration, with normal spring constant $k_n = 425$ N/m, deformation speed of $1 \mu\text{m/s}$, bead diameters $D_1 = 374 \mu\text{m}$ and $D_2 = 392 \mu\text{m}$, and bridge diameter $d = 105 \mu\text{m}$.

Movie S2 (*S2_shear_test.avi*)

Movie of a micromechanical test in the tangential configuration, with tangential spring constant $k_t = 16$ N/m, deformation speed of $1 \mu\text{m/s}$, bead diameters $D_1 = 396 \mu\text{m}$ and $D_2 = 364 \mu\text{m}$, and bridge diameter $d = 75 \mu\text{m}$.

Movie S3 (*S3_sample_A_particles_movie.avi*)

Movie illustrating the particle detection for the X-ray microtomogram of Sample A. The movie pans through cross-sectional views of the sample. The detected particles have been replaced by black spheres, of diameter $200.9 \mu\text{m}$, to demonstrate the fidelity of the image processing. A list of the detected particle positions is given in the accompanying file *S1_sample_A_particles_positions.txt*.

Movie S4 (*S4_sample_B_particles_movie.avi*)

Movie illustrating the particle detection for the X-ray microtomogram of Sample B. A list of the detected particle positions is given in the accompanying file *S2_sample_B_particles_positions.txt*.

Movie S5 (*S5_sample_A_simulation.mp4*)

Movie showing example DEM simulation of uniaxial compression test with particle positions taken from sample A. The bead colour indicates, δ_z , the relative displacement along the axis of compression, z , of each particle relative to its position at zero strain, normalised by the particles diameter. This visualisation is consistent with that reported in the matching experiments, in Ref. [1].

Movie S6 (*S6_sample_B_simulation.mp4*)

Movie showing example DEM simulation of uniaxial compression test with particle positions taken from sample B.

II. SUPPLEMENTAL TABLE CAPTIONS

Table S1 (*S1_sample_A_particles_positions.txt*)

Position of the centre of each particle detected in the X-ray microtomogram of sample A (voxel size = $4.875 \mu\text{m}$).
Columns 1 and 2 : x, y coordinates (in pixels, relative to the (x, y) centre of the stack).
Column 3 : z coordinate (in pixels, relative to the top of the stack).

Table S2 (*S2_sample_B_particles_positions.txt*)

Position of the centre of each particle detected in the X-ray microtomogram of sample B (voxel size = $4.493 \mu\text{m}$).
Columns 1 and 2 : x, y coordinates (in pixels, relative to the (x, y) centre of the stack).
Column 3 : z coordinate (in pixels, relative to the top of the stack).

[1] A. Hemmerle, M. Schröter and L. Goehring, *Sci. Rep.*, 2016, **6**, 35650.