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A multiscale MPMxDEM model for simulating snowpack deformation and failure.

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Fracture propagation in the snow-pack can lead to slab avalanches triggering. In the brittle deformation regime, snow can be viewed as a loose cohesive material. As shown in Discrete Element (DEM) simulations, the mechanical response of centimetric snow samples present complex patterns including strain-softening and volumetric collapse, with an important sensitiveness to the microstructure. On the other hand, avalanches involve large deformations and can propagate over hundreds or thousands of meters.

To tackle the challenge of modelling this wide variety of spatial scales, a double-scale MPMxDEM approach is proposed.
The MPM (Material Point Method) solver is used to compute the evolution of the flow at large scale and embeds a homogenized numerical constitutive law. Hence, each macroscopic lumping point is associated to its own microstructure, e.g. its own DEM cell, evolving independently. At the micro-scale, a loose assembly of spheres is considered with a cohesive contact law.

The ability of this method to capture the main features of snow mechalical behavior in a more robust manner than empirical analytical constitutive models will be investigated by simulating elemenary laboratory tests like oedometric test and field experiments like the Propagation Saw Test (PST).