**Discrete Element Modeling of Inter-Granular Bonds between Snow Grains**

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The mechanical behaviour of snow was long studied to help predict natural hazards, like avalanches. For those predictions the behaviour of snow deforming at low strain rates is of importance. On the other hand, a large group of industrial applications concerning trafficability and transportation safety also benefit from the understanding of snow physics. These applications requiring an understanding of the high strain rate behaviour of snow. The material behaviour of snow is based on its micro-structure. The micro-structure consists of ice grains connected by ice bonds building up an open-foam like structure. The macroscopic response of a snow pack to loading is determined by the deformation and failure of its bonds and the inter-granular friction whiles rearrangement of the grains. The work reported here proposes an inter-granular snow model developed and deployed using a discrete element technique. The goal is to understand the material behaviour of dry snow at high strain rates, from 0.01 $s^{-1}$ up to 100 $s^{-1}$. The developed algorithm predicts the displacement of the individual grains due to inter-granular contact and bond forces. The micro-structure of a snow pack is represented by generating an ensemble of explicit geometrical shapes describing the individual ice grains and bonds. The distributions of grain size and position are generated by gravitational deposition and by applying a fractal algorithm. Snow structures of densities from 200 kg $m^{-3}$ up to 600 kg $m^{-3}$ are generated. The developed inter-granular bond models assume a cylindrical neck between adjoining ice grains. Material properties and constitutive models of the hexagonal single- and poly-crystal Ih ice are used to describe the material behaviour of each individual bond. Simulations of tensile and compression tests have been conducted using samples of $10^3$ up to $10^5$ grains. Here, results of different parametric studies are reported. Assessed are the dependences of the macroscopic snow behaviour on microstructural properties and mechanical properties on grain-scale. These results are compared to experimental measurements and corresponding finite element simulations. The calculation results enable to identify primary deformation mechanism at the given strain rates.