



## Micromechanical modeling of crack propagation in weak snow layer

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Improving the prediction of snow avalanches requires a detailed understanding of the fracture behavior of snow, which is intimately linked to the mechanical properties of the snow layers (strength, elasticity of the weak and slab layer). While the basic concepts of avalanche release are conceptually relatively well understood, understanding crack propagation and fracture propensity remains a great challenge. About 15 years ago, the propagation saw test (PST) was developed. The PST is a fracture mechanical field test that provides information on crack propagation propensity in weak snowpack layers. It has become a valuable research tool to investigate processes and mechanical parameters involved in crack propagation.

Here, we use the discrete element method (DEM) to numerically simulate PST and therefore analyze fracture dynamics based on micromechanical approach. Using cohesive and non-cohesive ballistic deposition, we numerically reproduce the basic required layers for dry-snow avalanche: a highly porous and brittle weak layer covered by a dense cohesive slab.

The results of these numerical PTSs reproduce the main dynamics of crack propagation observed in the field. We developed different indicators to define the crack tip and therefore derive the crack velocity. Our results show that crack propagation on flat terrain reaches a stationary velocity if the snow column is long enough. The length of the snow column to reach stationary crack velocity depends on snowpack parameters. On sloped terrain our results show a transition in the local failure mode, this transition can be visualized from the crack tip morphology and from the main stress component.

Overall, our results lay the foundation for a comprehensive study on the influence of the snowpack mechanical properties on these fundamental processes for avalanche release.