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Modelling of the Vajont rockslide displacements by delayed plasticity of interacting sliding blocks

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In order to model complex sliding masses subject to continuous slow movements related to water table fluctuations it is convenient to: i) model the time-dependent mechanical behaviour of the materials by means of a viscous-plastic constitutive law; ii) assume the water table fluctuation as the main input to induce displacement acceleration; iii) consider, the 3D constrains by maintaining a level of simplicity such to allow the implementation into EWS (Early Warning System) for risk management.
In this work a 1D pseudo-dynamic visco-plastic model (Secondi et al. 2011), based on Perzyna's delayed plasticity theory is applied. The sliding mass is considered as a rigid block subject to its self weight, inertial forces and seepage forces varying with time. All non-linearities are lumped in a thin layer positioned between the rigid block and the stable bedrock. The mechanical response of this interface is assumed to be visco-plastic. The viscous nucleus is assumed to be of the exponential type, so that irreversible strains develop for both positive and negative values of the yield function; the sliding mass is discretized in blocks to cope with complex rockslide geometries; the friction angle is assumed to reduce with strain rate assuming a sort of strain – rate law (Dietrich-Ruina law).
To validate the improvements introduced in this paper the simulation of the displacements of the Vajont rockslide from 1960 to the failure, occurred on October the 9th 1963, is perfomed.
It will be shown that, in its modified version, the model satisfactorily fits the Vajont pre-collapse displacements triggered by the fluctuation of the Vajont lake level and the associated groundwater level. The model is able to follow the critical acceleration of the motion with a minimal change in friction properties.The discretization in interacting sliding blocks confirms its suitability to model the complex 3D rockslide behaviour.
We are currently implementing a multi-block model capable to include the mutual influence of multiple blocks, characterized by different geometry and groundwater levels, shear zone properties and type of interconnection.

Secondi M., Crosta G., Di Prisco C., Frigerio G., Frattini P., Agliardi F. (2011) "Landslide motion forecasting by a dynamic visco-plastic model", Proc. The Second World Landslide Forum, L09 - Advances in slope modelling, Rome, 3-9 October 2011, paper WLF2-2011-0571