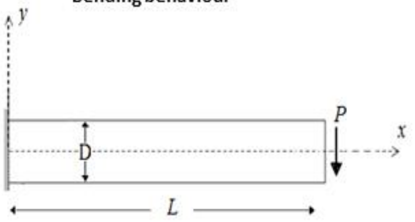
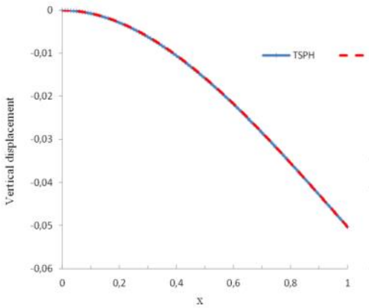
Development of a new numerical model for the study of geodynamical processes in the Solar System: deformation and failure of geomaterials under dynamic conditions

Bending behaviour

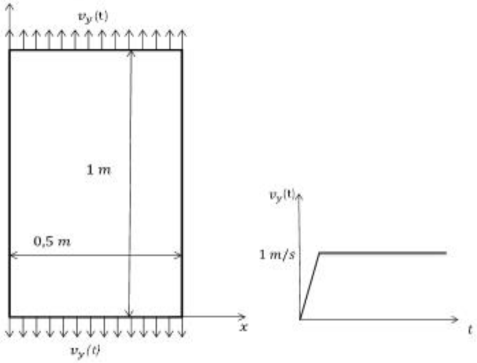


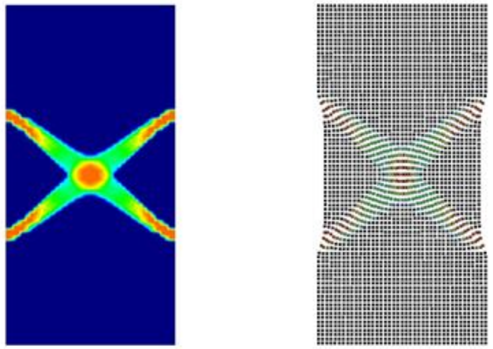


Particles	$\lvert u_{y\,exact} \rvert$	$\lvert u_{y\,num} \rvert$	$Error_{L2}(\%)$
63	0.05034	0.04655	7.52
205	0.05034	0.04841	3.83
729	0.05034	0.04936	1.94
1111	0.05034	0.05029	0.099

Vertical displacement along the material and L2 norm error in displacement

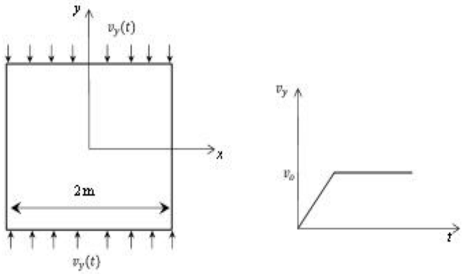
Specimen under tension

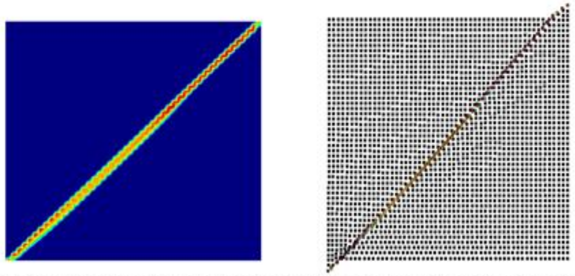




Effective viscoplastic strain of the specimen and deformed configuration

Plate under compression





Effective viscoplastic strain localization in ¼ of the plate and deformed configuration

CREDIT: CAB (CSIC-INTA) / Université Abdelmalek Essaâdi

Geodynamical processes are responsible for the relief in planetary bodies, giving rise to different geographical accidents and structural forms in the crust.

External geodynamical processes that affect planetary surfaces may produce changes in the terrain of different characteristics: landslides, sinking, subsidence, fractures. These modifications are often associated with various factors such as gravity, weakening of materials or variations in effective stresses, as well as other natural and environmental agents (erosion, earthquakes, rain, chemical degradation, biological or human action, etc.). Research into the physical phenomena involved in these processes can help us understand the conditions in which the crust of the rocky bodies of our Solar System has been shaped, shedding information on their geological past, evolution and environmental conditions in which these changes took place.

Development of mathematical and numerical models allowing to reproduce these phenomena are of paramount importance in order to draw conclusions about the conditions under which the changes observed in the terrain occur or have ever occurred.

When the geodynamical process involves the soil deformation or the localized failure of the terrain, the mechanism can be described within the frame of the Solid Mechanics. To this end, the UL TSPH (Updated Lagrangian Taylor-SPH) has recently been developed at CAB in collaboration with the Université Abdelmalek Essaâdi. It consists of a meshless numerical model capable of reproducing the deformation and failure of materials under dynamic conditions. This model has been validated by comparing the obtained results with well-known mathematical solutions, demonstrating that the UL TSPH is accurate, efficient and easy to implement, thus becoming a useful tool for the study of certain geodynamical processes such as fracture and fragmentation of the crust, sinking and land subsidence.

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