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Multipole Boundary Element Application in Solid Earth and Ice Mechanics

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We present a large variety of applications of the Boundary Element Method exploiting a Multipole formulation, ranging from global planetary scale geodynamics down to crystal Ice or rocks deformation. The motivation for this approach is the scaling growth of 3-D data-assimilation that makes increasingly difficult to achieve the necessary performance for simulating their mechanical behaviour in a single simulation. In order to overcome such limitation we translate the equations to be solved into a boundary formulation in which only the few surfaces where the constitutive material properties change are explicitly meshed and where the equations in the integral form are solved. The main advantage of such an approach is the reduction of the spatial dimensionality by one, due to construction of a boundary integral equation on the surfaces instead of the volumes. This approach, classically neglected because it requires the build of highly memory expensive dense matrices, can be speed up to linear scaling, as the best FD or FEM, employing the Fast Multipole Method approach, but with the advantage of a smaller memory requirement, that makes it better predisposed for implementation on the most modern highly parallelized multicore machines.