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WORK – ENERGY BALANCE FOR DISCRETE ELEMENT METHOD ON THE EXAMPLE OF SHEAR STRESS TESTS.

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Study of the physical characteristics of soil is becoming more and more complex because of the increasing number of challenges in construction engineering. A phenomenological, pore-scale, virtual hydrodynamics laboratory, called SimSols, is being developed to illustrate the processes that saturated and unsaturated soils undergo under static and dynamic loads. SimSols can reproduce different tests that are standard for soil sciences in order to better understand the complex behavior through visualization and without the usual instrumental challenges involved in studying the question. Being discrete in its nature, the granular material's behavior can be assessed by using the Discrete Element Method (DEM). Because DEM based simulations are numerically intensive, a parallel computation approach was favored. The OpenCL framework was used in order to achieve a high level of data parallelism on NVIDIA Graphics Processing Units (GPU) based Tesla High Performance Computing (HPC) hardware. Using the OpenGL Application Programming Interface (API) and Alioscopy technology, autostereoscopic visualization is proposed. This model was tested in various conditions. The proposed paper is focused on shear tests on samples consisting of glass beads. First, the comparison of numerical and laboratory tests will be presented for different particle-size distribution (PSD) curves. Second, the work-energy balance will be analyzed. The mechanical energy balance is a type of energy balance that may provide useful information about the complex behavior of soils under different loads. The discussion begins with the analysis of energy conservation for different types of particles' interaction. On the other hand, the influence of mechanical parameters as friction coefficient, Young's module etc., will be presented. Finally, the full work-energy balance during the direct shear tests will be presented and analyzed. The obtained results and future works will be discussed.