Development of high-performance low order unstructured implicit finite-element solvers for solid earth science problems

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Problems in solid earth science, such as crust deformation problems and earthquake wave propagation problems, involve large problem sizes with complex 3D geometry and heterogeneous material properties. Use of implicit low-order finite-element methods on high-performance computers are expected to enable such analyses; however, these methods are not straightforward to attain performance on modern computer architectures due to heterogeneity of the problem. Thus, we have been developing algorithms and implementations to improve performance of low-order finite-element methods targeting recent CPU and heterogeneous supercomputer systems. In this talk, we will introduce our development for the CPU based systems (e.g., K computer, Intel Xeon-Phi Knights Landing based Oakforest-PACS) as well as heterogeneous systems (e.g. NVIDIA GPU accelerated Piz Daint and Summit), and show some application examples using these high-performance computing enhanced methods.

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