Solving Fracture Mechanics Problems Using Reconfigurable Computing

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Abstract

Fracture mechanics is of paramount importance for assessing the behavior of structures under operational conditions. Complex fracture mechanics problems demand very high computing power. In this paper, we describe a novel application of reconfigurable computing for solving such problems. We have experimented with FRACT3D, our own developed fracture mechanics code running on a host machine attached with a reconfigurable platform. This code has an equation solver block consisting mainly of Cholesky factorization, a computationally intense routine having complexity of $(1/3)n^3$ flops and forward-backward substitution steps. The Cholesky factorization and forward-backward substitution modules are developed as double precision hardware library elements. During FRACT3D execution, calls to the factorization or substitution routines on the reconfigurable hardware are made to provide acceleration. As the FPGA cannot accommodate at the same time, the complete logic for factorization and substitution, the FPGA is on-the-fly reconfigured with the substitution logic, once the factorization is over.