2
Related Work

Cohesive models represent effective tools for numerical simulation of various separation phenomena in solids such as fracture, microbranching, and fragmentation (13, 18, 4). In this work, we focus on the extrinsic cohesive zone model (27), and investigate its parallel implementation on a many-core architecture.

Different researches have investigated parallel simulations to improve the performance of finite element analysis, addressing the use of a distributed memory architecture (25, 11). Fracture, microbranching, and fragmentation simulation introduces new challenges since modeling interface elements is required. Dooley et al. (6) present a parallel implementation of dynamic fracture simulation on extrinsic cohesive models using ParFUM, a parallel framework specifically developed for parallel finite element applications (15). Radovitzky et al. (22) have opted for parallelizing extrinsic fracture and fragmentation simulations based on a combination of a discontinuous Galerkin formulation and cohesive zone models. Like Dooley et al. (6), cohesive elements are pre-inserted throughout the mesh. Espinha et al. (7) developed ParTops, a topological distributed mesh representation for parallel dynamic simulation of fragmentation phenomena based on the extrinsic cohesive zone model.

Several works have also explored the use of GPU for numerical simulation other than fracture or fragmentation. Rodriguez-Navarro and Susin (23) have implemented cloth simulation on the GPU using finite element method for triangle meshes. Previous studies on FEM in GPUs also focused on solving large sparse linear systems (23, 9, 1) using CUDA. They have also explored the strategy of mesh coloring for minimizing conflicts, thus avoiding excessive use of CUDA atomic operations, which usually degrade performance. Komatitsch et al. (14) use CUDA to speedup numerical simulation of seismic wave propagation resulting from earthquakes.