CSSI Element: **Fast Dynamic Load Balancing Tools for Extreme Scale Systems**

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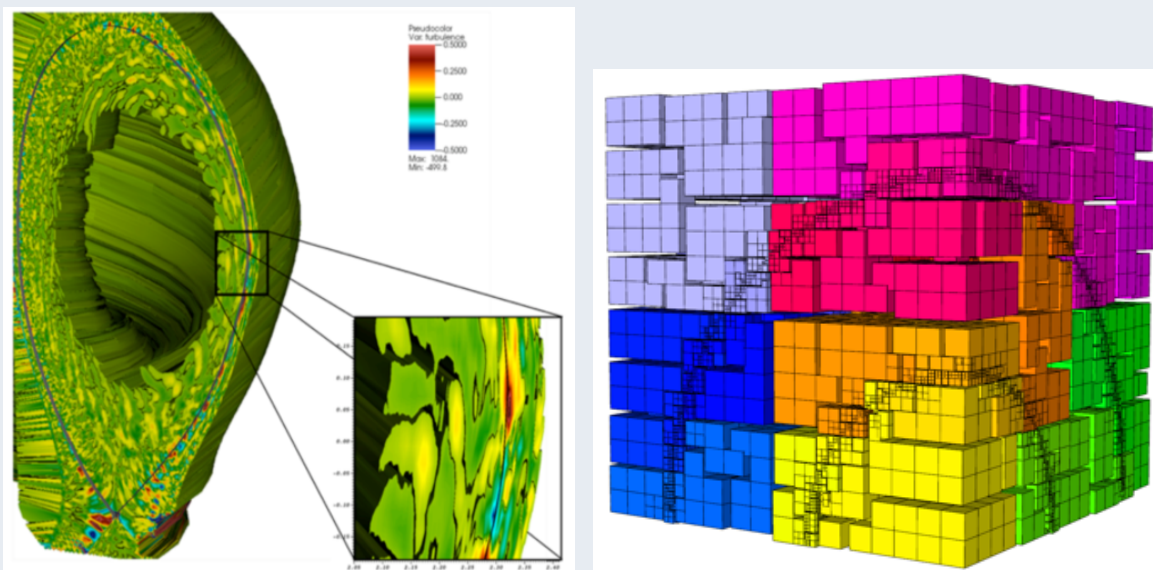
Motivation and Focus

GPUs provide >90% of the compute power on leadership systems.

Simulations with regions of physical interest that change can have

- complex relational structures,
- irregular forms of computational & communication costs, and
- evolving imbalance of work characterized by multiple criteria.

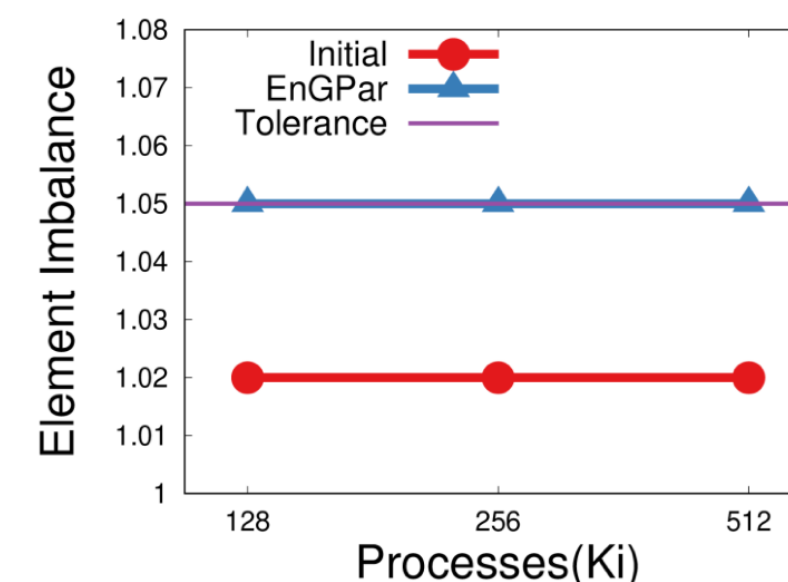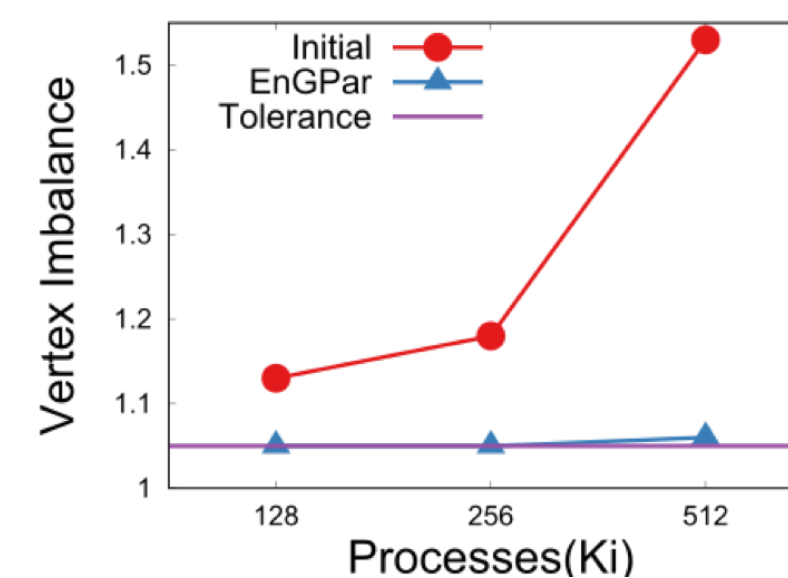Provide fast dynamic load balancing on GPUs where simulation data exists.

XGC fusion plasma physics (left) and MFEM Laghos Sedov blast (right).

Element Partition: Mesh Vertex Imbalance Reduction
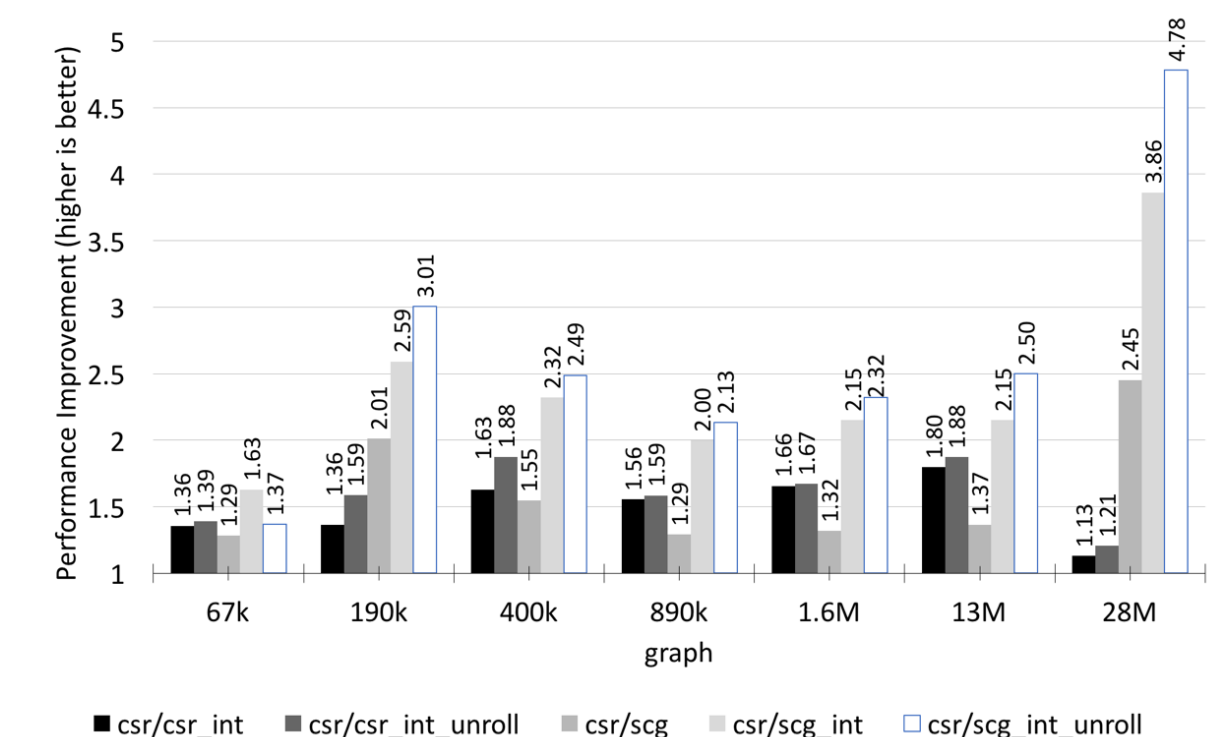
The partitions before using EnGPar:

Number of Parts	128Ki	256Ki	512Ki
Elements per part	9,836	4,918	2,459
Vertex imbalance	1.13	1.18	1.53
Element imbalance	1.02	1.02	1.02

Mesh vertex imbalances are reduced from 13% to 5% for 128Ki, 18% to 5% for 256Ki, and 53% to 6% for 512Ki. Edge cut is increased by 1%.
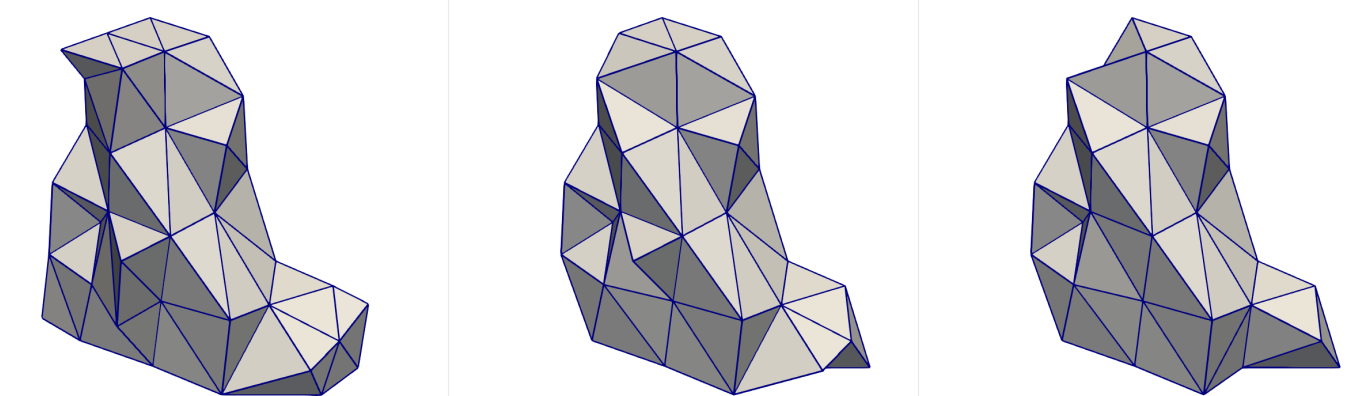
Accelerating BFS with OpenCL and Selection with Kokkos

push: C++ serial push, **pull**: C++ serial 'pull', **csr**: OpenCL 'pull' on CSR, **scg**: OpenCL 'pull' on Sell-C-Sigma, ***_int**: 4B int, ***_unroll**: unroll the vtx-to-hyperedge loop

Making good decisions

Initial, GPU Selection, CPU Selection Bias selection towards cavities with highest topological distance.