

Project Proposal

Geometric multigrid solver using a hierarchical mesh

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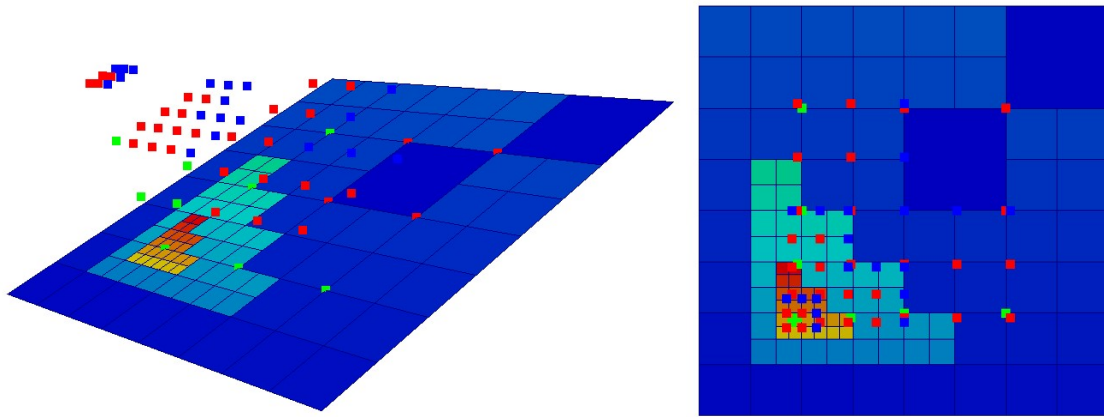


Fig 1: Hierarchical refined mesh. Dots represent b-spline basis for each refinement level.

CU Boulder's Center for Aerospace Structures develops its own Finite Element Optimization code, "Moris". This code should be able to perform Multiphysics Finite Element Analysis. One existing functionality of this code is it, to create a hierarchical mesh shown in Figure 1. The degrees of freedom are expressed by B-Spline basis. The benefit of this hierarchical structure is that the mesh can be refined according to an arbitrary criterion.

The idea of this project is to exploit the hierarchical nature of the B-spline basis to create prolongation and restriction operators which can then be used to create a geometric multigrid preconditioner.

Therefore, the hierarchical mesh generator must be modified in a way that it calculates the projection stencils corresponding to the pairs of fine and coarse B-spline basis.

The "Model Solver Interface" must calculate the ordering of the prolongation and restriction operators based on dof type and time and the underlying B-spline basis.

Finally, the prolongation and restriction operator will be build in the solver module. It will be used by a third-party library like PETSc or Trilinos to solve the system of linear equations.

The results will be compared against results created with standard preconditioners like ILU.

