TUG 2008
Meshes, Geometry and
Load Balancing Capability Area

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Meshes, Geometry and Load Balancing Capability Area

- **Motivation:** Generation, management and manipulation of mesh-based data play key roles in many scientific simulations.
  - *Finite difference, volume, and element methods* require efficient mesh generation and management.
  - *Adaptive mesh refinement methods* require even more sophisticated mesh management, along with the ability to modify, manipulate, and redistribute mesh and geometry data.

- **Goal:** Provide tools and common interfaces for creating, accessing and manipulating mesh and matrix data within applications.

Capabilities in Trilinos

- **New and Improved in Trilinos v9.0:**
  - PhDMesh
  - PAMGEN
  - Zoltan
  - Isorropia

- **Planned for Trilinos v10++:**
 - ABMesh
  - TUCASA
  - STKMesh
  - ITAPS

phdMesh
Unstructured Mesh Database

- **POC: Carter Edwards**
- **History: Mesh kernel for Mantevo project.**
- **Capabilities:**
  - **Compact, flexible software component for managing parallel, heterogeneous and dynamic unstructured meshes.**
  - **Mesh specified as application-defined parts, fields, entities and connections.**
  - **Blocking data into contiguous memory provides high computational efficiency.**
- **Brag: phdMesh provides an API and implementation that is an order of magnitude simpler/smaller than SIERRA Framework.**

proximity

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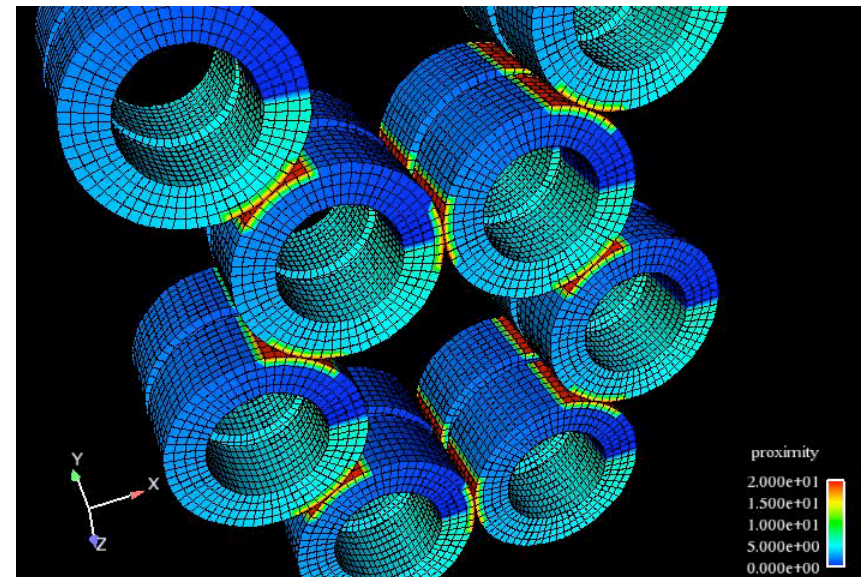
PAMGEN
In-Line Meshing Library

- **POC: David Hensinger**
- **History: Spin-off from ALEGRA.**
- **Capabilities:**
  - **On-the-fly parallel generation of simple meshes.**
  - **C interface to local mesh geometry and topology as well as inter-processor connections.**
- **Brag: PAMGEN has been used to generate meshes with more than 1.1B elements on 17,576 processors.**
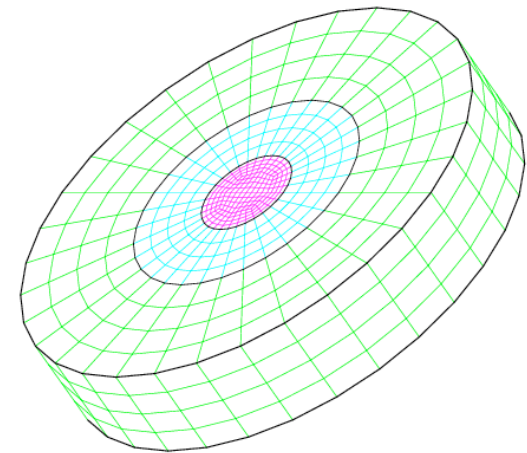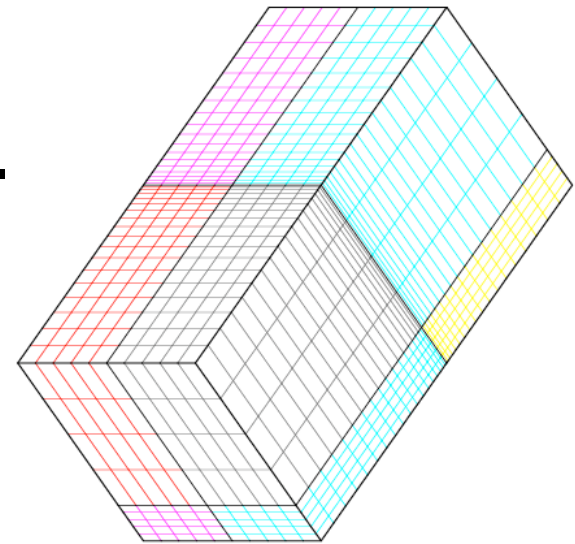
Zoltan
Dynamic Load Balancing Toolkit

- **POC: Karen Devine**
- **History: Spin-off from MPSalsa.**
- **Capabilities:**
  - **Suite of partitioning and load-balancing methods for many applications (meshes, particles, circuits, matrices, …).**
  - **Graph coloring, graph ordering, distributed data directories, unstructured communication.**
- **Brag: Zoltan is used by over a dozen Sandia applications, as well as the SciDAC, lab, and academic communities.**
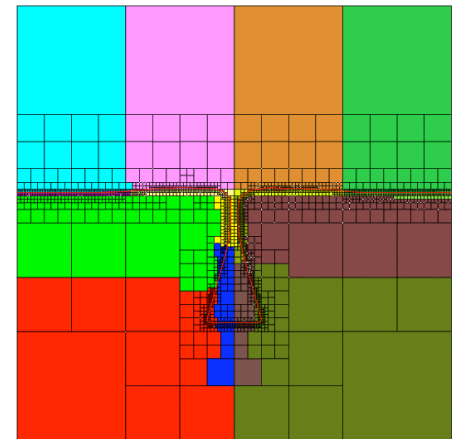
Isorropia Matrix Partitioning, Coloring & Ordering

- **POC: Erik Boman**
- **History: First released in Trilinos v8.**
- **Capabilities:**
  - Epetra interfaces to Zoltan; connects Zoltan to the rest of Trilinos.
  - Matrix redistribution tools.
  - Development platform for advanced matrix partitioning and ordering algorithms.
- **Brag: Isorropia in Trilinos v9 contains new matrix ordering and coloring interfaces. (POC: Cedric Chevalier)**
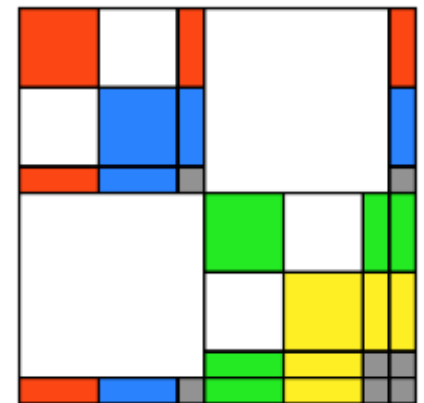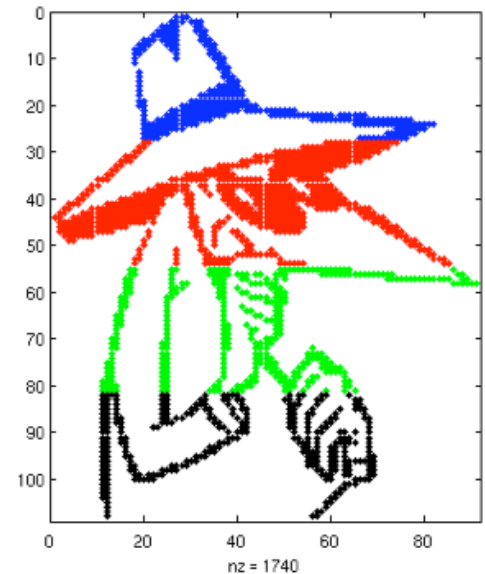
Future Tools in Capability Area

- **ABMesh: Array-based mesh database.**
  - POC: Rich Drake
- **TUCASA: Parallel mesh file reader and initial partitioner.**
  - POC: Rich Drake
- **STK Mesh: Sierra Toolkit Mesh component.**
  - POC: Carter Edwards and Mike Glass
- **ITAPS: Interoperable parallel mesh interfaces.**
  - POC: Vitus Leung and Karen Devine