

Capabilities of ElmerGrid



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Elmer User Meeting
29.5.2006

Outline

- Introduction to ElmerGrid
- Mesh generation capabilities
- Import capabilities
- Mesh manipulation capabilities
- Conclusions

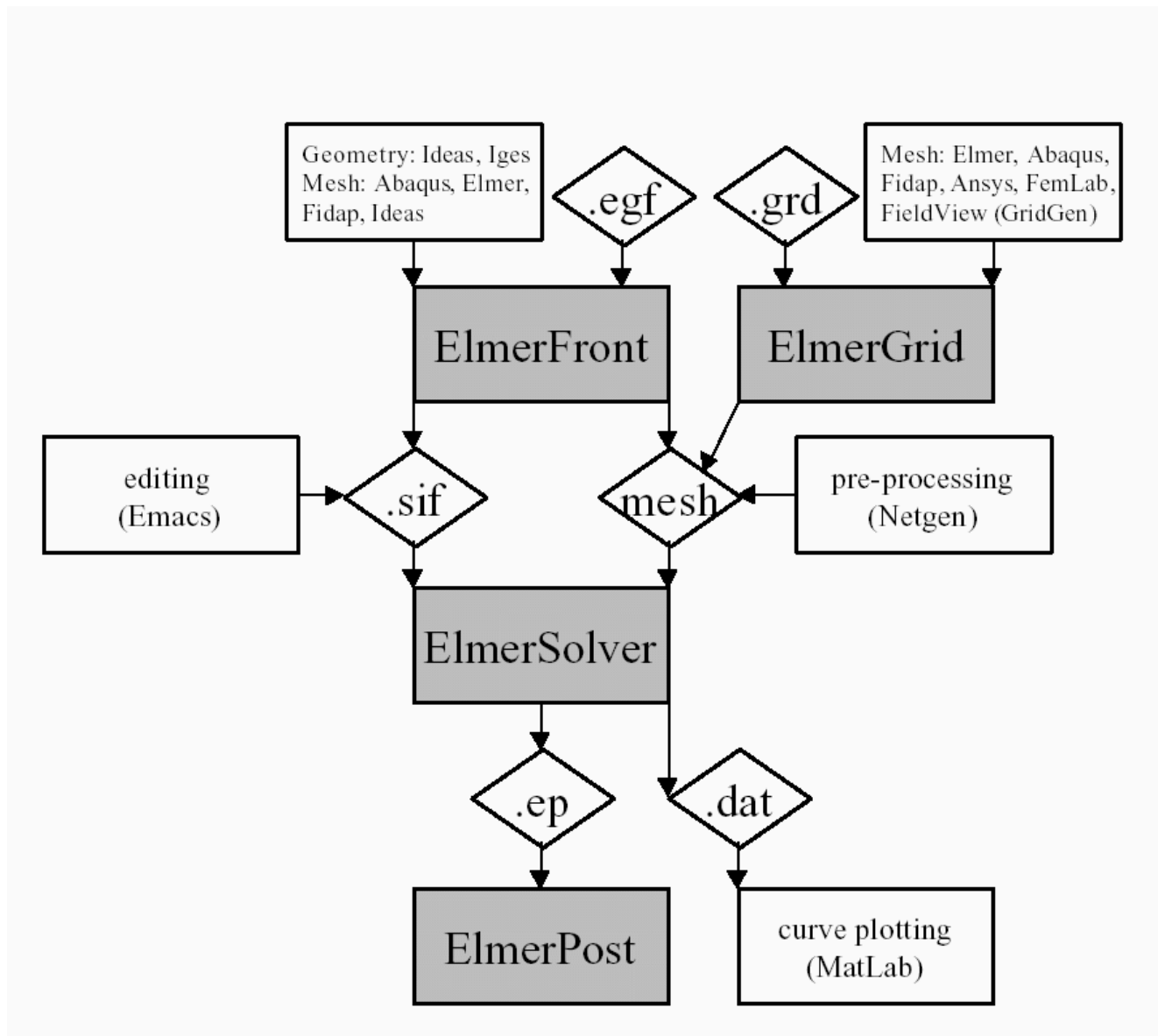
Intro - ElmerGrid Basics

- command line tool for mesh generation
- executable name: `ElmerGrid`
- native mesh format file: `grd`
- native command format file: `eg`
- short help when no parameters given

Intro - Position in Elmer family

- development started independently
- gradually became widely used toy-tool in Elmer development
- was renamed ElmerGrid
- initially mesh generation in Elmer was done with ElmerFront which calls Meshgen2D Delaunay mesher
- ElmerGrid provides an alternative ways for mesh generation
- Elmer package may be used without ElmerGrid
- ElmerGrid may be used without other Elmer component

Intro - Workflow in Elmer simulations



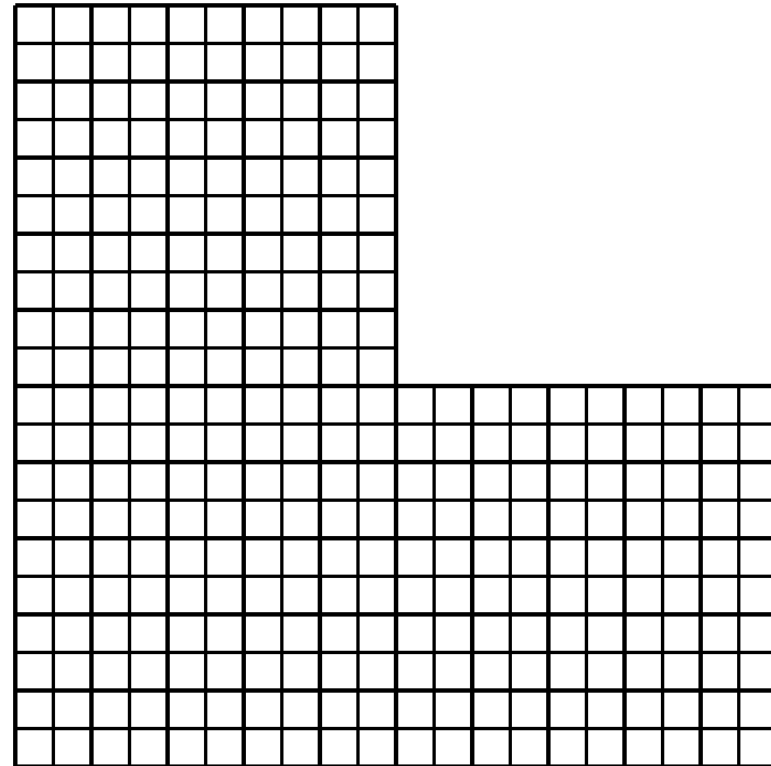
Mesh generation - 2D

- mesh is thought to consist of “subcells” with a number
- the subcell grid is given dimensions and relative (or absolute) mesh density parameters
- boundary conditions are determined by neighbourhood relations
- desired number of of elements is distributed considering the given constraints
- element order and type may be defined
- subcells boundaries may be mapped to non-rectangular forms
- same mesh file may be used to create a number of meshes with different number of elements, or different domains, etc.

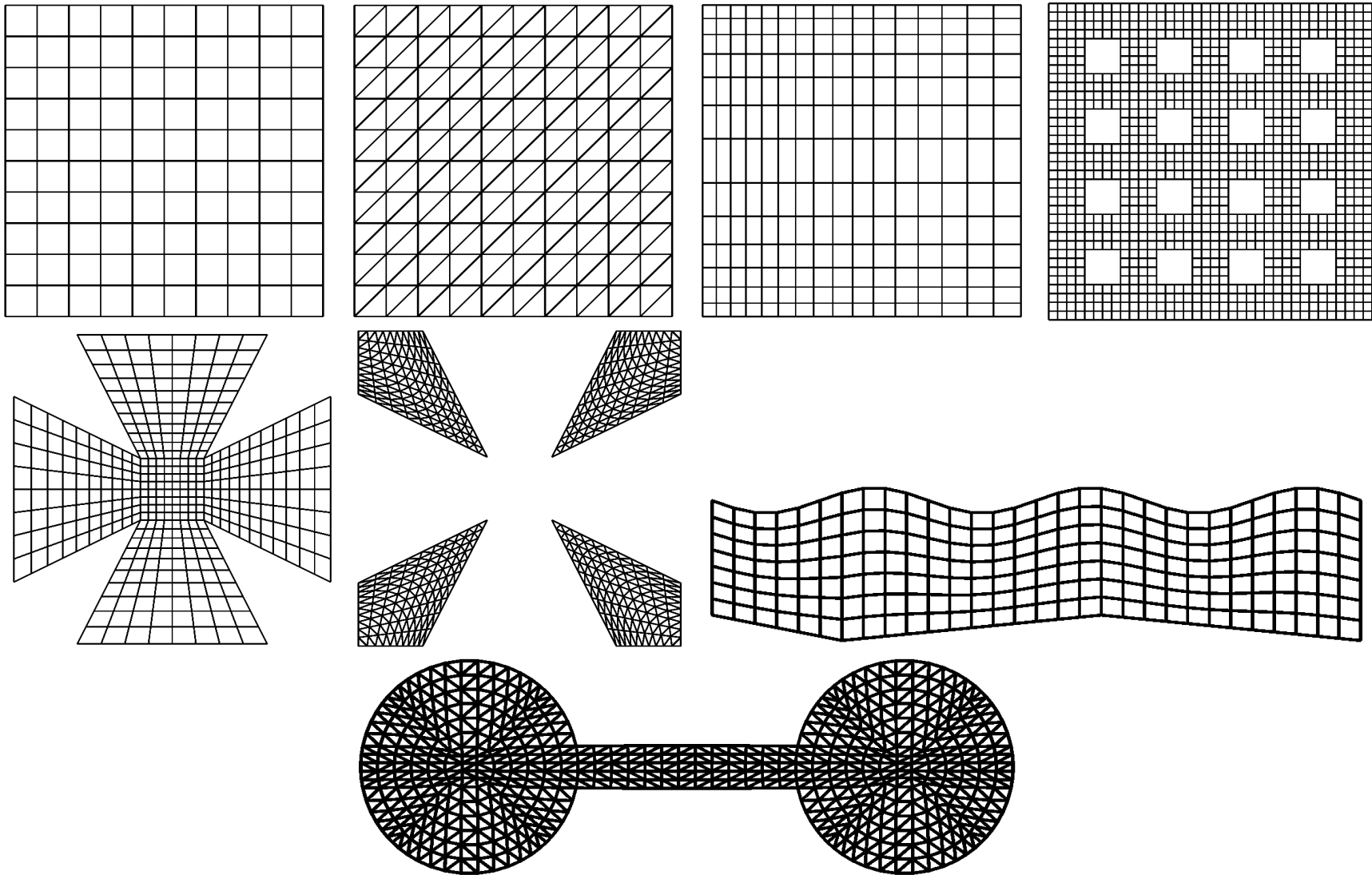
Mesh generation - 2D angle

ElmerGrid file for a L-shaped domain.

```
Version = 210903
Coordinate System = Cartesian 2D
Subcell Divisions in 2D = 2 2
Subcell Sizes 1 = 1 1
Subcell Sizes 2 = 1 1
Material Structure in 2D
  1 0
  1 1
End
Boundary Definitions
! type      out      int
  1 1 0 1 1
End
Element Degree = 1
Surface Elements = 300
```



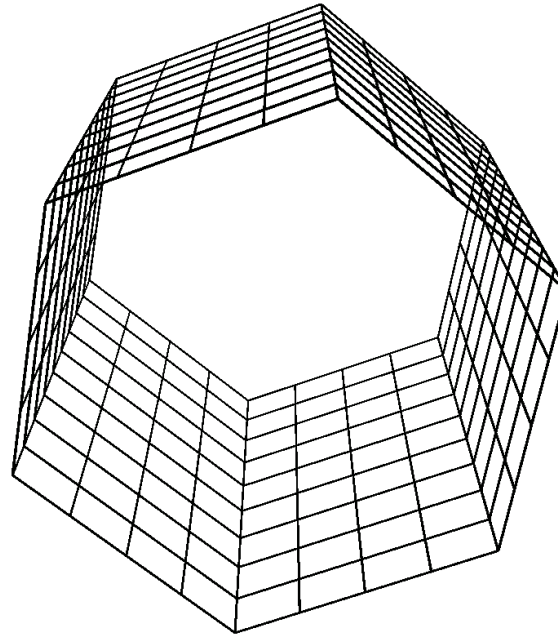
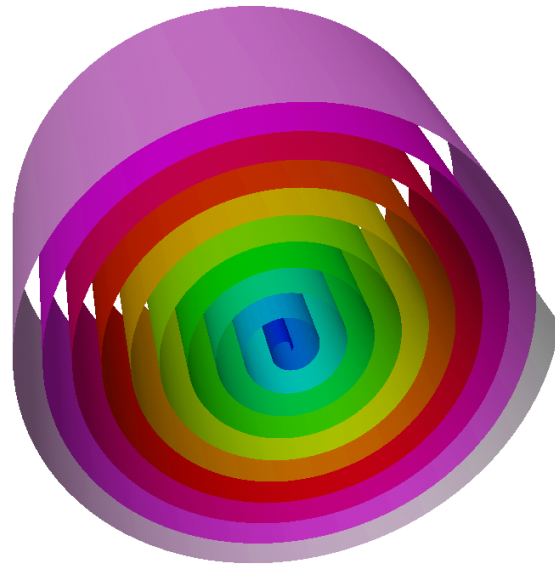
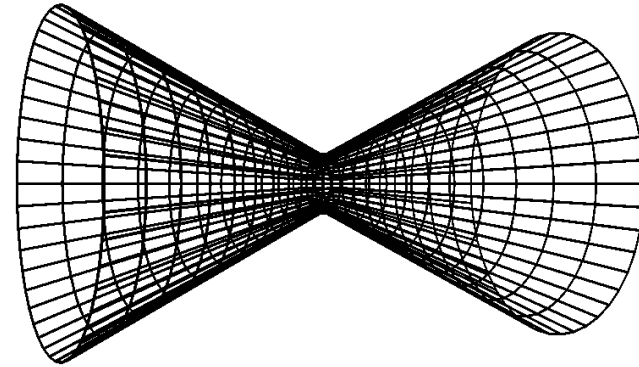
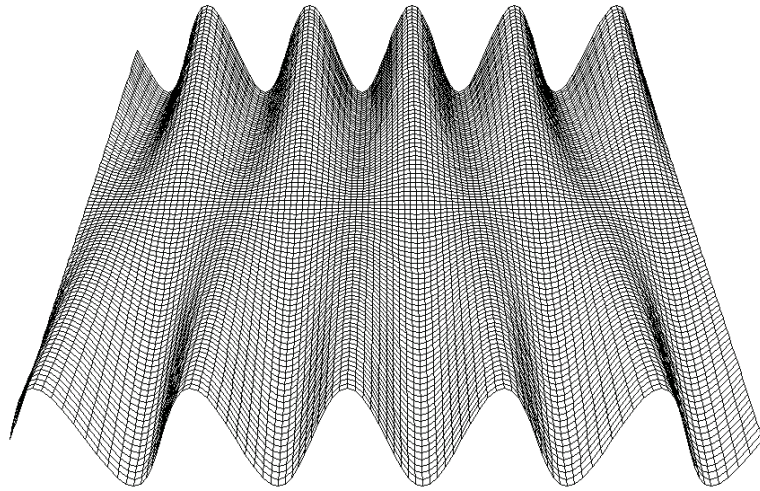
Mesh generation - 2D examples



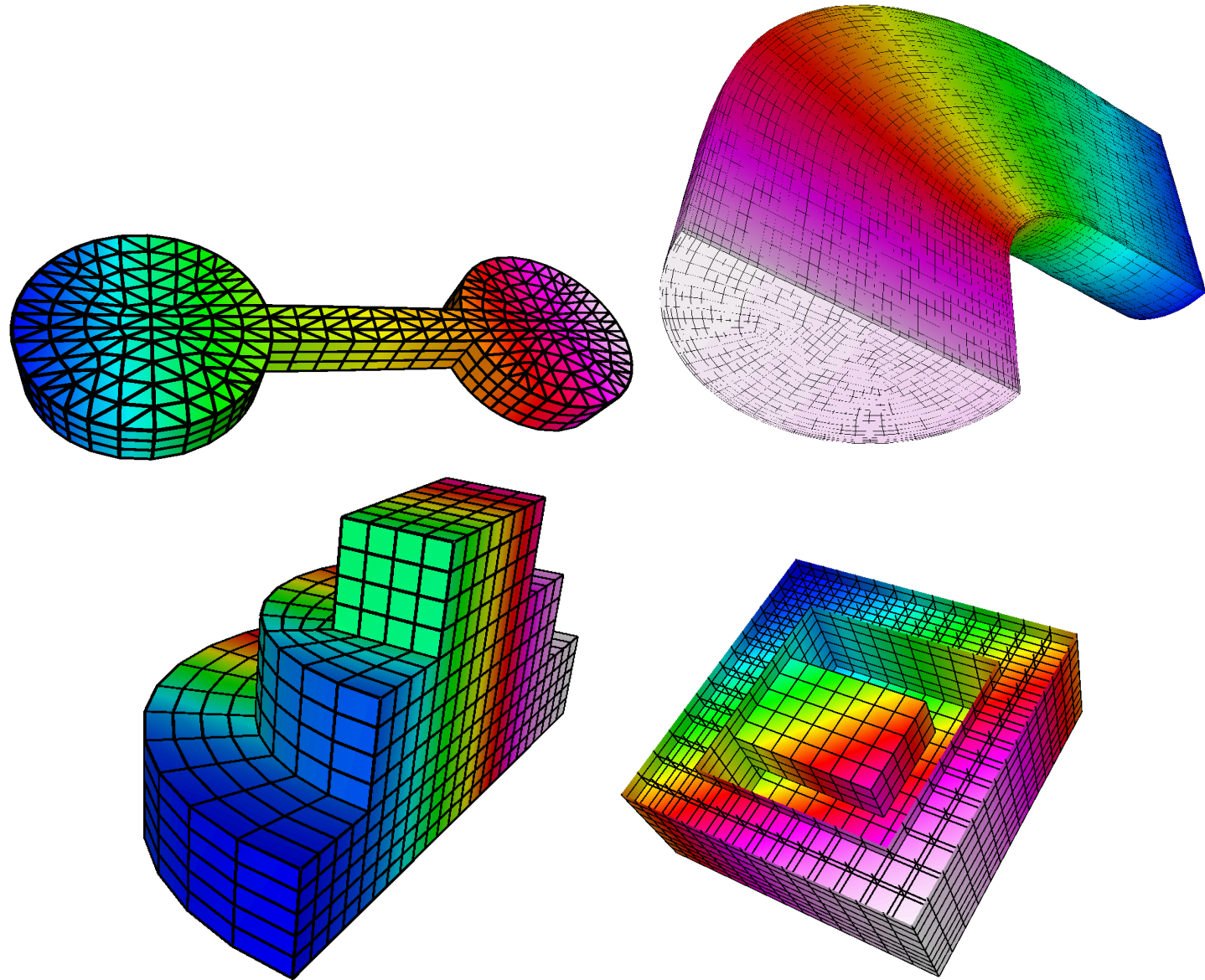
Mesh generation - 3D

- Rotation of 2D meshes
- Extrusion of 2D meshes
- Mapping of 2D meshes into third dimension

Mesh generation - mapped 3D examples



Mesh generation - rotated and extruded 3D examples



Mesh import

- Important way to use ElmerGrid in mesh generation is to import meshes produced by other free or commercial mesh generators.
- Each import format has a corresponding command line
- Parsers for the mesh generators have been written case-by-case and therefore no general applicability is to be expected
- Supported formats include: Ansys, Abaqus, Fidap (Gambit), Comsol Multiphysics, FieldView (Gridgen), Medit, and Gmsh.

Mesh import - Ansys

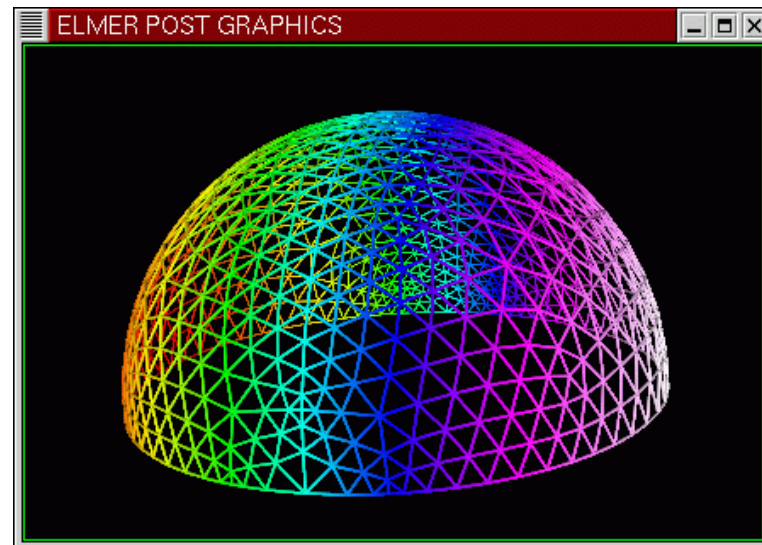
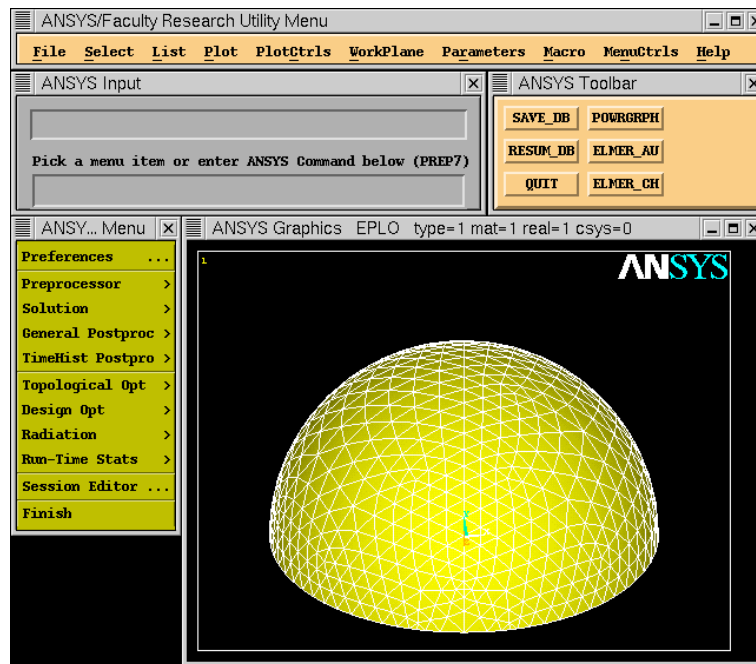
Command file for importing a Ansys mesh (created with a Ansys script) into Elmer format.

Input File = ExportMesh

Output File = mesh

Input Mode = Ansys

Output Mode = ElmerSolver



Mesh import - Comsol Multiphysics

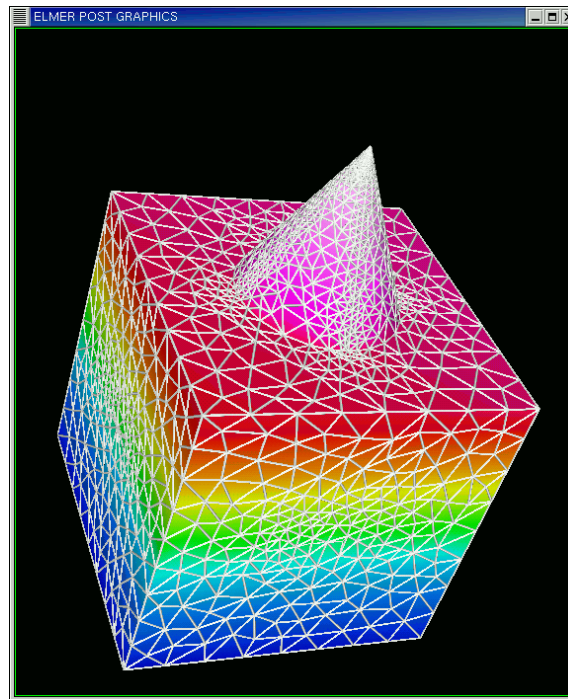
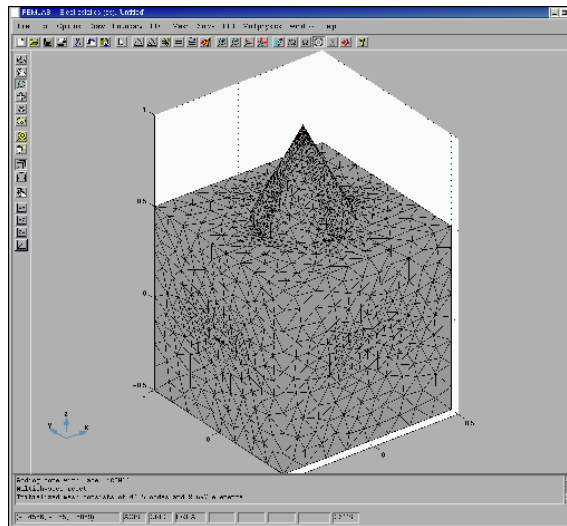
Command file for importing a mpxtxt-format mesh from Comsol Multiphysics into Elmer format.

Input File = mesh

Output File = mesh

Input Mode = Comsol

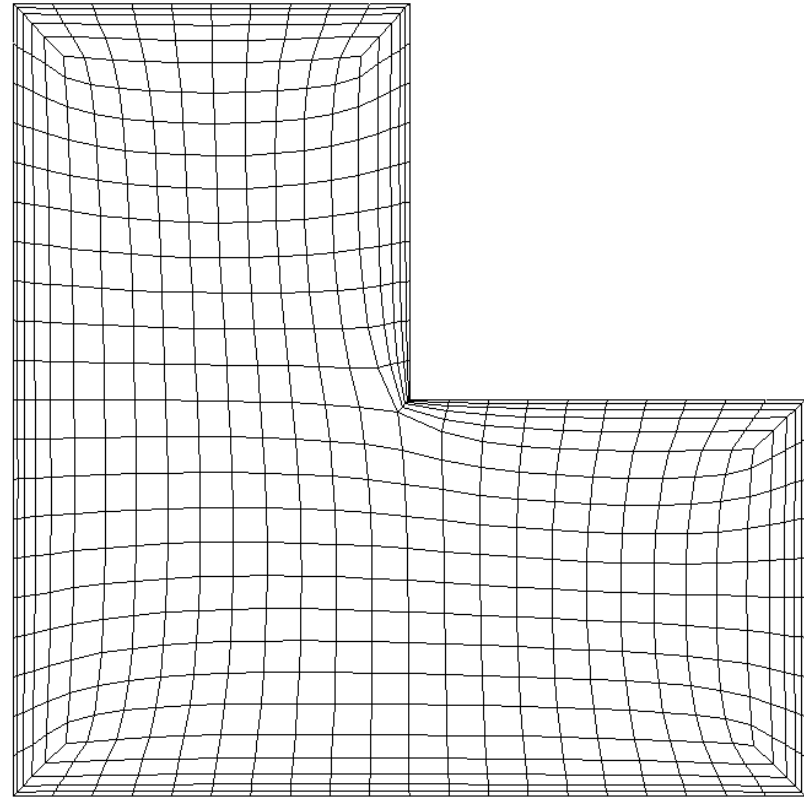
Output Mode = ElmerSolver



Mesh manipulation - boundary layer creation

Command file for creating a boundary layer of 5 elements for a 2D mesh. The mesh is distorted so that the original mesh size is conserved.

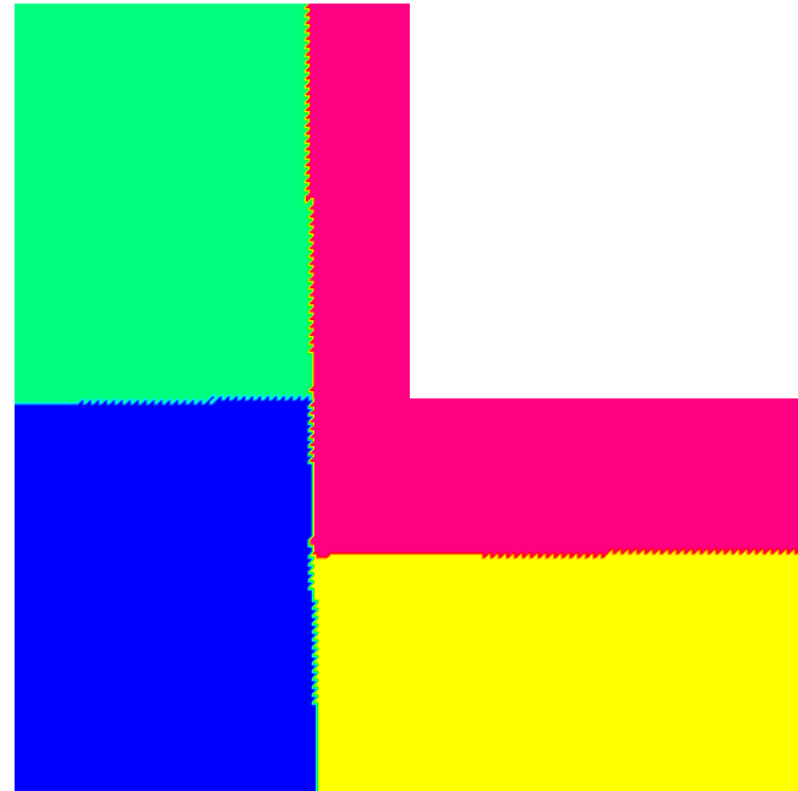
```
Input File = angle
Output File = layer
Input Mode = ElmerGrid
Output Mode = ElmerPost
Boundary Layer Move = True
Boundary Layer
  1 5 0.2 5.0 0
END
```



Mesh manipulation - simple partitioning

Command file for using the simple partitioning scheme to partition the mesh into 2×2 domains.

```
Input File = angle  
Output File = angle  
Input Mode = ElmerGrid  
Output Mode = ElmerPost  
Partition = 2 2
```



Mesh manipulation - Metis partitioning

Command file for using the simple partitioning scheme to partition the mesh into 2×2 domains.

```
Input File = angle
Output File = angle
Input Mode = ElmerGrid
Output Mode = ElmerPost
Metis = 4
```



Conclusions - When to use ElmerGrid

- simple 2D structured mesh
- extruded and rotated 3D meshes derived from the above
- parametrized mesh generation
- import meshes created by other mesh generators to ElmerSolver
- as a pre- and postprocessor in parallel runs

Conclusions - When not to use ElmerGrid

- complicated geometries
- unstructured mesh generation
- graphical interface is desired
- for teaching purposes
- for industry standard

Conslucions - Future plans

- development of ElmerGrid is driven solely by user needs
- no major changes planned - would require rewriting of data structures
- bug fixes
- new import possibilities
- minor mesh manipulation features
- ...