FEM2D
Files Describing a 2D Finite Element Model

FEM2D is a data directory which contains examples of 2D FEM files, which define a 2D finite element model.

The FEM format is a simple dataset that can be used to describe the nodes, elements, and functions associated with a finite element model.

The finite element model may include files defining the following:

- a *node file*, containing node coordinates (in 1D, 2D or 3D);
- an *element file*, defining elements by a sequence of node indices (for this simple format, we assume the elements are all of the same order). Depending on convenience, the nodes might be indexed using a 0-based or 1-based scheme.
- a *value file*, listing one or more (real) values associated with each node.
- a *boundary node mask file*, containing a 0 for each interior node, a 1 for each boundary node.

FEM File Characteristics:

- ASCII
- Each line is one "record"
- Each record is either a comment record or a data record;
- Comment records begin with the "#" character;
- A data record records node coordinates for one node, or the node indices for one element, or the set of node data for one node;
- For a given file, each data record contains the same number of items, separated by blanks.

Licensing:

The computer code and data files described and made available on this web page are distributed under the GNU LGPL license.

Related Data and Programs:

FEM2D_HEAT, a C++ program which solves the 2D time dependent heat equation on the unit square.

FEM2D_POISSON, a FORTRAN90 program which solves the 2D Poisson equation on a rectangle, using the finite element method, and piecewise quadratic triangular elements.

TRIANGULATION_BOUNDARY_NODES, a C++ program which reads data defining a triangulation, determines which nodes lie on the boundary, and writes their coordinates to a file.

TRIANGULATION_DISPLAY, a MATLAB program which displays the nodes and elements of a triangulation on the MATLAB graphics screen;

TRIANGULATION_DISPLAY_OPENGL, a C++ program which reads files defining a 2D triangulation and displays an image using OpenGL.

Reference:

1. Hans Rudolf Schwarz,
   Methode der Finiten Elemente,
   Teubner Studienbuecher, 1980,
   ISBN: 3-519-02349-0.
2. Gilbert Strang, George Fix,
   An Analysis of the Finite Element Method,
   Cambridge, 1973,
   ISBN: 096140888X,
   LC: TA335.S77.
3. Olgierd Zienkiewicz,
   The Finite Element Method,
   Sixth Edition,
   Butterworth-Heinemann, 2005,
   ISBN: 0750663200,
   LC: TA640.2.Z54

Sample Files:

BIG_CAVITY is a square region, with a grid of 8,185 nodes and 4000 elements of order 6 triangles. The values file contains the horizontal and vertical components of velocity at each node.

- big_cavity_nodes.txt
- big_cavity_elements.txt
- big_cavity_elements.png, an image of the triangulation.
- big_cavity_values.txt
- big_cavity_boundary_node_mask.txt, 0 for interior nodes, 1 for boundary nodes, 368 boundary nodes total.

CHANNEL is a 10x3 rectangular region, with a 11x4 grid of 44 nodes and 60 elements of order 3 triangles. The values file contains the horizontal and vertical components of velocity, and the pressure, at each node.

- channel_nodes.txt
- channel_elements.txt
- channel_values.txt
- channel_boundary_node_mask.txt, 0 for interior nodes, 1 for boundary nodes, 26 boundary nodes total.

ELL is an L-shaped region, with a grid of 65 nodes and 96 elements of order 3 triangles.

- ell_nodes.txt
- ell_elements.txt
- ell_elements.png, an image of the triangulation.
- ell_values.txt
- ell_boundary_node_mask.txt, 0 for interior nodes, 1 for boundary nodes, 32 boundary nodes total.

GREENLAND is a triangulation of Greenland, using 33,343 nodes and 64,125 elements of order 3 triangles.

- greenland_nodes.txt
- greenland_elements.txt
- greenland.png, an image of a portion of the triangulation, after "zooming in" twice.
- greenland_boundary_node_mask.txt, 0 for interior nodes, 1 for boundary nodes, 2559 boundary nodes

total.

LAKE is a triangulation of a lake, using 621 nodes and 974 elements of order 3 triangles.

- lake_nodes.txt
- lake_elements.txt
- lake_elements.png, an image of the triangulation.
- lake_values.txt
- lake_boundary_node_mask.txt, 0 for interior nodes, 1 for boundary nodes, 268 boundary nodes total.

TINY is a "tiny" example using 5 nodes and 3 elements of order 3 triangles.

- tiny_nodes.txt
- tiny_elements.txt
- tiny_elements.png, an image of the triangulation.
- tiny_values.txt
- tiny_boundary_node_mask.txt, 0 for interior nodes, 1 for boundary nodes, 5 boundary nodes total.

You can go up one level to the DATA directory.

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