MESH_BANDWIDTH
Geometric Bandwidth of a Mesh

MESH_BANDWIDTH is a FORTRAN90 program which computes the geometric bandwidth of a mesh.
The user specifies an element file, containing the indices of the nodes that make up each element. Examples of such a file include the order 3 and order 6 triangulation files, but any order of element may be used.
Not only may any element type be used, but the geometric region may be of any spatial dimension.
The program reads the element information and computes the geometric bandwidth **M** as

M = ML + 1 + MU

where **ML** is the lower bandwidth, namely, the maximum value over all nodes **I** of the difference **(I-J)**, taken over all nodes **J** that share an element with node **I**. The upper bandwidth is the maximum value of **(J-I)** under the same conditions.
The geometric bandwidth **M** is the linear algebraic bandwidth of the adjacency matrix of the mesh, where **I** and **J** are considered to be adjacent if there is some element that includes both nodes.
The geometric bandwidth is of interest since it is the bandwidth of the finite element matrix associated with the mesh, when a scalar quantity is being approximated and there is a single unknown for every node, and the unknowns have the same numbering as the nodes.

Usage:

mesh_bandwidth *element_file*

where
element_file contains a list of the node indices that form each triangle of the triangulation, computes and prints the geometric bandwidth.

Licensing:

Languages:

MESH_BANDWIDTH is available in a C version and a C++ version and a FORTRAN77 version and a FORTRAN90 version and a MATLAB version.

Related Data and Programs:

TABLE_DELAUNAY, a FORTRAN90 program which triangulates a set of nodes whose coordinates are stored in a file.

TET_MESH_RCM, a FORTRAN90 program which applies the reverse Cuthill-McKee reordering to a tetrahedral mesh of nodes in 3D.
TRIANGULATION_DISPLAY_OPENGL, a C++ program which reads files defining a triangulation and displays an image using Open GL.
TRIANGULATION_ORDER3, a data directory which contains a description and examples of order 3 triangulations.
TRIANGULATION_ORDER6, a data directory which contains a description and examples of order 6 triangulations.
TRIANGULATION_PLOT, a FORTRAN90 program which reads data defining a triangulation and creates a PostScript image of the nodes and triangles.

Reference:

Alan George, Joseph Liu,
Computer Solution of Large Sparse Positive Definite Matrices,
Prentice Hall, 1981,
QA 188.G46
Norman Gibbs, William Poole, Paul Stockmeyer,
An Algorithm for Reducing the Bandwidth and Profile of a Sparse Matrix,
SIAM Journal on Numerical Analysis,
Volume 13, pages 236-250, 1976.
Norman Gibbs,
Algorithm 509: A Hybrid Profile Reduction Algorithm,
ACM Transactions on Mathematical Software,
Volume 2, Issue 4, pages 378-387, 1976.
Joseph ORourke,
Computational Geometry,
Cambridge University Press,
Second Edition, 1998.

Source Code:

mesh_bandwidth.f90, the source code.

Examples and Tests:

mesh_bandwidth_prb_output.txt, the resulting output.
Some sample mesh files include:
sphere_q4_elements.txt
sphere_t3_elements.txt
cube_order4_tetras.txt
twenty_order4_tetras.txt
cube_order10_tetras.txt
oneoneeight_order10_tetras.txt
ell_tri3.txt
hex_cvt_tri3.txt
hex_triangle_tri3.txt
hot_pipe_tri3.txt
ell_tri6.txt

hex_jeff_tri6.txt

List of Routines:

MAIN is the main program for MESH_BANDWIDTH.
BANDWIDTH determines the bandwidth associated with the finite element mesh.
FILE_COLUMN_COUNT counts the number of columns in the first line of a file.
FILE_ROW_COUNT counts the number of row records in a file.
GET_UNIT returns a free FORTRAN unit number.
I4MAT_TRANSPOSE_PRINT_SOME prints some of the transpose of an I4MAT.
ITABLE_DATA_READ reads data from an integer table file.
ITABLE_HEADER_READ reads the header from an integer table file.
S_TO_I4 reads an I4 from a string.
S_TO_I4VEC reads an I4VEC from a string.
S_WORD_COUNT counts the number of "words" in a string.
TIMESTAMP prints the current YMDHMS date as a time stamp.
TIMESTRING writes the current YMDHMS date into a string.
You can go up one level to the FORTRAN90 source codes.

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