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function MeshData = generateRecMesh(dx1,dx2,x1_lim1,x1_lim2,x2_lim1,x2_lim2)
% $Author : Vignesh Ramakrishnan$
% $RIN : 662028006$ $Date : November 21, 2021$
% $Code Version: 1.0$
% Inputs: dx1 - discretization along x1-axis
%          dx2 - discretization along x2-axis
%          x1_lim1 - lower limit of x1 dimension of the domain to mesh
%          x1_lim2 - upper limit of x1 dimension of the domain to mesh
%          x2_lim1 - lower limit of x2 dimension of the domain to mesh
%          x2_lim2 - upper limit of x2 dimension of the domain to mesh
% Outputs: struct mesh
%          mesh.dim          - holds the dimension of the domain = 2
%          mesh.num_elem     - Number of rectangular elements present in the
%                               domain
%          mesh.num_node     - Number of nodal elements present in the domain
%          mesh.DOF          - 2D Matrix with each node holding its DOF value
%          mesh.CornerDOF    - 1D array holding the DOF values of domain
%                               corners
%          mesh.BoundaryDOF - 1D array holding the DOF values of domain
%                               boundary
%          mesh.GridFn       - 2D cell array with each cell holding the
%                               domain location of each nodal DOF
%          mesh.DimLen       - 1x2 array that holds total number of points
%                               along x1 and x2 direction
%          mesh.DX           - [dx1 dx2]: discretization along x1 and x2

% Generate [X1 X2] - Values along which to generate rectangular mesh
x1 = x1_lim1:dx1:x1_lim2;
x2 = x2_lim1:dx2:x2_lim2;

% dimension of domain
dim = 2;

Nnodes = length(x1)*length(x2);
Nelem = (length(x1)-1)*(length(x2)-1);

MeshDOF = zeros(length(x2),length(x1));
GridFn = cell(length(x2),length(x1));
k = 1;
b_dof = 1;
c_dof = 1;
corner_dof = zeros(2*dim,1);
per = 2*(length(x1)-1) + 2*(length(x2)-1);
boundary_dof = zeros(per,1);
for i=1:length(x2)
    for j=1:length(x1)
        MeshDOF(i,j) = k;
        GridFn{i,j} = [x1(j),x2(i)];
        if i==1 && j==1 % corner 1
            corner_dof(c_dof) = k;
            c_dof = c_dof + 1;
        elseif i==1 && j==length(x1) % corner 2
            corner_dof(c_dof) = k;
            c_dof = c_dof + 1;
        elseif i==length(x2) && j==1 % corner 3
            corner_dof(c_dof) = k;
            c_dof = c_dof + 1;
        elseif i==length(x2) && j==length(x1) % corner 4
            corner_dof(c_dof) = k;

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        c_dof = c_dof + 1;
    end
    if i==1
        boundary_dof(b_dof) = k;
        b_dof = b_dof + 1;
    elseif j==1 || j==length(x1)
        boundary_dof(b_dof) = k;
        b_dof = b_dof + 1;
    elseif i == length(x2)
        boundary_dof(b_dof) = k;
        b_dof = b_dof + 1;
    end

    k = k + 1;
end
end
MeshData.dim = dim;
MeshData.num_elem = Nelem;
MeshData.num_node = Nnodes;
MeshData.DOF = MeshDOF;
MeshData.CornerDOF = corner_dof;
MeshData.BoundaryDOF = boundary_dof;
MeshData.GridFn = GridFn;
MeshData.DimLen = [length(x1) length(x2)];
MeshData.DX = [dx1 dx2];
end

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