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% Program 8.7 Implicit Newton solver for Burgers equation (Fluid Flow)
% *** Nonlinear PDE: Diffusion Eqn ***
% ==> Burgers Eqn (Fluid Flow Model) with Dirichlet Boundary
Conditions
% ***==> Example 8.12 <==***
% input: space interval [xl,xr], time interval [tb,te],
%        number of space steps M, number of time steps N
% output: solution w
% Example usage:
%      1. clear all; clearvars; close all; clc;
%      2. w=burgers(0,1,0,2,20,40)
function w=burgers(xl,xr,tb,te,M,N)
% alpha, beta, Diffusion Coefficient
alf=5;bet=4;D=.05;
f=@(x) 2*D*bet*pi*sin(pi*x)./(alf+bet*cos(pi*x));
l=@(t) 0*t;
r=@(t) 0*t;
% Space Step
h=(xr-xl)/M;
% Time Step Size
k=(te-tb)/N;
% Square-Matrix Size
m=M+1;
% Time Step
n=N;
sigma=D*k/(h*h);

% Initial Conditions set by Function call "f"
w(:,1)=f(xl+(0:M)*h)';
w1=w;

% Time-Step Loop
for j=1:n
    % Space-Step Loop
    for it=1:3 % Multivariate Newton iteration (Jacobian: 3x3 partial
derivatives)
        % matrix DF1: collects derivatives of degree 1 terms of F
        DF1=zeros(m,m); % 21x21 matrix
        % matrix DF2: collects derivatives of degree 2 terms of F
        DF2=zeros(m,m); % 21x21 matrix
        %
        DF1=diag(1+2*sigma*ones(m,1))+diag(-sigma*ones(m-1,1),1);
        DF1=DF1+diag(-sigma*ones(m-1,1),-1);
        DF2=diag([0;k*w1(3:m)/(2*h);0])-diag([0;k*w1(1:(m-2))/(2*h);0]);
        DF2=DF2+diag([0;k*w1(2:m-1)/(2*h)],1)-diag([k*w1(2:m-1)/
(2*h);0],-1);
        DF=DF1+DF2;
        F=-w(:,j)+(DF1+DF2/2)*w1; % Using Lemma 8.11 (P441)
        DF(1,:)= [1 zeros(1,m-1)]; % Dirichlet conditions for DF
        DF(m,:)= [zeros(1,m-1) 1];

        % Dirichlet conditions for F

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F(1)=w1(1)-l(j);
F(m)=w1(m)-r(j);

% Multivariate Newton
w1=w1-DF\F;
end
% Each pass adds another column
w(:,j+1)=w1;

end
x=xl+(0:M)*h;t=tb+(0:n)*k;
mesh(x,t,w');
%w_transpose = w';

title({'Nonlinear PDE: Diffusion Eqn';
      'Burgers Eqn (Fluid Flow Model) with Dirichlet Boundary
      Conditions';
      '***==> Example 8.12 <==***: [21 x 21 Matrices]'});
xlabel('x');
ylabel('t');
zlabel('Fluid Flow');

Not enough input arguments.

Error in burgers (line 18)
h=(xr-xl)/M;

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