21. BOUNDARY PROBLEM SIMULATION

Principle:

1. Construction of a SIMULINK model for solution of a differential equation $f(x, y, y', y'') = 0$ for $y(x_a) = y_a$ and a chosen value of $\widehat{y'}(x_a)$ in the range $\langle x_a, x_b \rangle$
2. Construction of a MATLAB programme to use the SIMULINK model for the initial value problem to evaluate value $\hat{y}(x_b)$ and its use for estimation of the new value of the second initial condition:
$$\widehat{y'}(x_a) = \widehat{y'}(x_a) - \alpha\,(\hat{y}(x_b) - y(x_b)) \text{ for a chosen } \alpha$$
3. Iterative repetition

BLOCKS

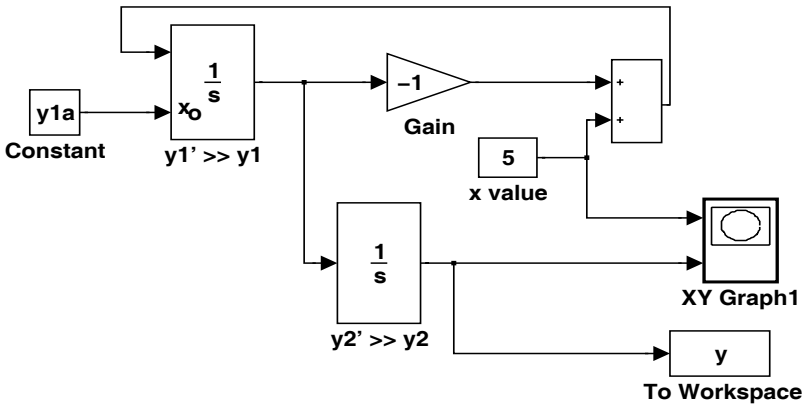
INTE-GRATION

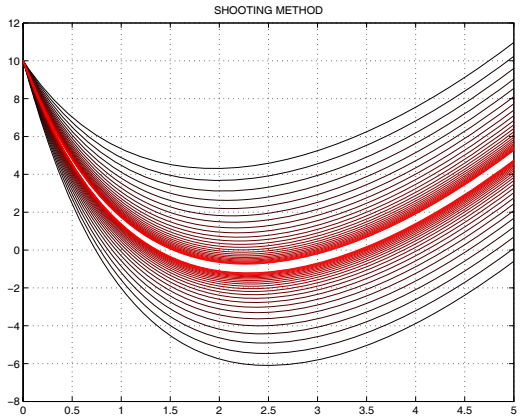
SUMMATION
CONSTANT
CLOCK

XYGRAPH

TO WORKSPACE

```
%%% Example 21.1: % Solution of  the boundary problem by shooting method
%%% Using simulation in the SIMULINK environment
%%% Differential equation f(x,y,y',y'')=y''+y'-x=0, y(0)=10, y(5)=5
  clear all; close all; clc
  y1a=input('The choice on initial condition (=-20): ')
% Simulation
  alpha=1.95; y2b=5; M=50;
  BoundaryProblem; sim('BoundaryProblem')
  for i=1:M
    y1a=y1a-alpha*(y.signals.values(end,1)-y2b);
    sim('BoundaryProblem')
    plot(tout,y.signals.values,'Color',[1/M*i 0 0]); grid on; hold on
    pause(0.2)
  end
  hold off
%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
  function dy=ff(x,y) dy=[-y(1)+x; y(1)];
```





Notes:

1. Depending upon the value of α the whole process can be stable or unstable, monotonic or oscilating
2. The SIMULINK run is controlled by the MATLAB programme

EXAMPLES 21

21.1 Evaluate solution of a boundary value problem for ordinary differential equations in the SIMULINK environment using the shooting method

21.2 Compare numeric solution obtained in the previous example with the symbolic one