CH2013

Aug-Dec 2019

**MATLAB Exercise #7**

1. Write a function “**euler**” which takes h, xi and yi as input arguments and yields yi+1 as the output, for the solution of this ODE

1. First analytically integrate the equation, and find y(x), and evaluate its value at x=[0,0.5,1,1.5,2,2.5,3,3.5,4]. Let this vector of y values be labelled ‘yan’.
2. Next, use the Euler’s method with h=0.5 to find value of y at various x, and put them in a vector ‘yEuler1’
3. With h=0.1, use Euler’s method again, and let the vector of y values be ‘yEuler2’
4. Plot yan, yEuler1, yEuler2 vs. x on the same plot using symbols and lines to distinguish.
5. Solve the above differential equation using the MATLAB built-in function ‘**ode45**’ and plot the resulting y – call it yode45– vs. x, and compare it with the analytical solution.
6. MATLAB’s inbuilt function **ode15s** can handle stiff ODEs very well. Recall a problem discussed in class, for which you tried the explicit Euler’s method and it failed:

The analytical solution is known

Solve the system of ODEs using ode15s and compare it with the analytical solution by plotting them together. Let in intervals of 0.1

Look at the plot – see how the region at low t has sharp gradients.

*I will check the following: vector t; vector yan and zan which represent the analytical solution at t; yode15s and zode15s which are from the ode15s solution.*

1. The Finite Difference based method for solution of BVP-ODEs involves the conversion of the original ODEs into a system of linear/non-linear equations, which need to be solved in order to determine the Yi at each ti. *The boundary conditions may be the Dirichlet (function values), Neumannn (derivative values) or mixed (function value at one point, derivative at the other) kind.*

1. This can be translated to a set of linear equations with h=1, as below.

*(for i=1,9)*

Set up the matrix version of the linear equations problem, as where

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Solve for T using LU decomposition, Gauss elimination or just the inverse method (using MATLAB functions, no need to write your own code for these). Plot T vs. t.

*I plan to examine A, b, and the final solution T.*

1. Rework the problem for h=2, and do the same steps for solution as above. Let this equation be represented as where the matrix W replaces A above. And the new temperature is T2. *I will examine W,c and the final solution T2.*
2. Plot the temperatures T and T2 together and think about the result.

TODAY IS THE LAST OFFICIAL CLASS. PLEASE GO THROUGH ALL THE MATERIAL WE HAVE WORKED ON THROUGH THE SEMESTER AND PRACTICE IF YOU HAVE TIME NOW.