

In the name of God

Department of Physics  
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ADVANCED COURSE ON COMPUTATIONAL PHYSICS

Exercise Set 8

(Due Date: 1403/09/15)

1. Discretization: Use the "dataprofile.txt" and compute the derivative of signal with 3-point, 5-point, 7-point and 9-point neighbors in central difference formula (CDF). Compare your results. **Hint:** in the class I taught 3-point and 5-point central difference formula.
2. Implicit and Explicit methods for solving differential equation:  
**A:** Suppose that  $f' \equiv \frac{df(x)}{dx} = f^2(x)$  and step size  $\Delta x = 0.5$  and  $f(x = 1) = 1$ . Use explicit and implicit approaches to compute  $f(x)$ . Compare your results.  
**B:** Suppose that  $f' \equiv \frac{df(x)}{dx} = -f(x)$  and step size  $\Delta x = 0.5$  and  $f(x = 1) = 1$ . Use explicit and implicit approaches to compute  $f(x)$ . Compare your results.
3. Using Euler and RF4 methods  
**A:** Solve following initial value problem:

$$y''(t) + ay'(t) + \omega^2 y(t) = \cos(\omega_1 t)$$

with  $y(0) = A$ ,  $y'(0) = 0$  and take any arbitrary values for other free parameters. Plot the phase diagram, namely  $y'(t)$  as a function of  $y(t)$ .

**B:** Use the Mathematica to solve mentioned equation and compare your result with that determined by Mathematica.

Good luck, Movahed

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