

PHYS 8750**HW1****Due September 3, 2020**

1. Consider backward-Euler differencing and trapezoidal differencing schemes for the damping-oscillation problem:

$$\frac{d\psi}{dt} = F(\psi, t) = \gamma\psi = (\lambda + i\omega)\psi$$

- 1) Estimate the order of accuracy for these two difference schemes.
- 2) Derive A-stability criteria for these two difference schemes, compare your results with the figure below.

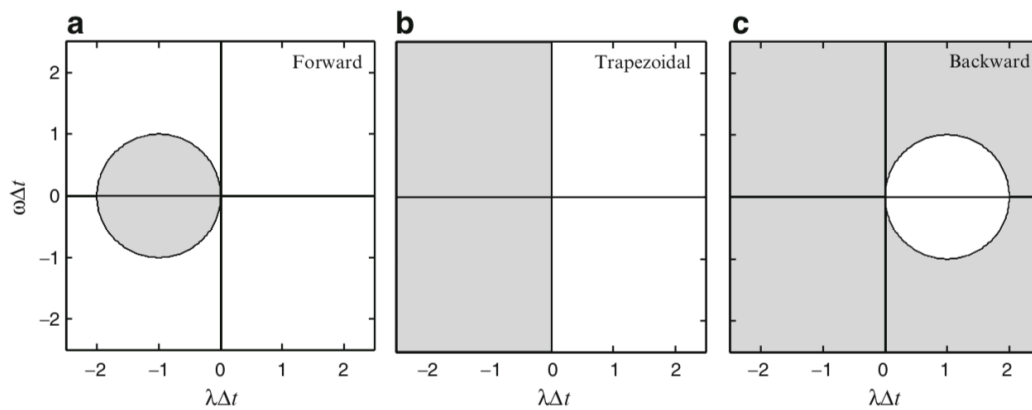


Fig. 2.1 Absolute stability regions (shaded) for **a** forward-Euler differencing, **b** trapezoidal differencing, and **c** backward-Euler differencing

2. Modify the code (AStabilityConvergence_ODE_FT.m) and make it work for backward differencing schemes. Choose different Δt and compare which one leads to the best convergence, which ones leads to unstable solution (you may refer to the matlab code provided).
3. Modify the code (AStabilityConvergence_ODE_FT.m) and make it work for trapezoidal differencing schemes. Choose different Δt and compare which one leads to the best convergence, which ones leads to unstable solution (you may refer to the matlab code provided). In this case, try positive λ .
4. Compare with forward, backward and trapezoidal schemes, and discuss what you find.