Week 13 - 21｜ODE and Numerical Analysis

2025-11-03 – 2026-01-04

1: Weekly Highlights

- Studied Numerical Analysis using UC Berkeley Math 128A and Ordinary Differential Equations using MIT 18.009
- Course study:
    MITOCV 18.009 Differential equation lecture 1 - 13
    UCB 128A Numerical Analysis lecture 1 - 11
- Finish all classes of 8.03 Vibration and Wave
- Conducted a Rayleigh scattering experiment using dilute HCl and $Na_2S_2O_3$ solution. Successfully observed linearly polarized scattered light. But due to equipment limitations, wavelength changes in the transmitted light were not observed. Plan to improve the setup by increasing the scattering path length.

2: Insights & Takeaways

- Starting from first-order linear ODE, mastered methods such as integrating factors and variation of parameters. Extended these ideas to second-order equations, analyzing forced, damping and resonance oscillations, building a solid mathematical foundation for dynamical laws in classical mechanics.
- Learned about sources of numerical error and the mechanism of floating-point computation. Gained familiarity with common root-finding algorithms and their convergence analysis. Through polynomial interpolation and divided differences, developed an understanding of function approximation and error estimation, laying the groundwork for numerical differentiation, integration, and numerical ODE methods.

3: Challenges & Open Questions

- Rayleigh scattering is not yet fully understood theoretically. I will revisit this topic in future physics studies.

4: Next Month Plan

- Finish nonlinear systems and phase plane analysis
- Start numerical ODE methods
- Use MATLAB to solve ODE