Introductory Numerical Methods for Simulating Dynamic Systems

Instructor

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Bio: Joshua is a post-doc at CMU working with Profs. Carl Laird and Ignacio Grossmann, and he specializes in developing methods in optimization under uncertainty and data science to solve problems pertaining to sustainability, energy, and the environment. He completed his Ph.D. at UW-Madison under the direction of Prof. Victor Zavala and obtained his B.Sc. at BYU, both in chemical engineering.

Course Summary

In this lecture, we will address how to simulate systems of ordinary differential equations (ODEs) using common numerical methods. In particular, we will explore the use of explicit and implicit Euler methods for approximating ODEs with consideration of their relative stability and accuracy. This will feature hands-on activities designed around applying these techniques to simulate reaction networks. Finally, we will highlight more advanced methods/tools commonly used to simulate ODEs.

Learning Outcomes

Attendees of this lecture will learn:

- The relative advantages/disadvantages of using explicit and implicit Euler methods
- How to implement explicit/implicit Euler to simulate ODEs using common computation environments (e.g., Python)
- How to simulate reaction networks using numerical methods
- A familiarity of other numerical methods/tools for simulating ODEs

Required Materials

- Personal laptop or tablet
- A positive learning mindset