Solving Linear Ordinary Differential Equations with constant coefficients

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Proposal for Subject of Course Project for the Numerical Methods course

Proposed Subject: Solving Linear Ordinary Differential Equations with constant coefficients

Linear Ordinary Differential Equations (ODEs) can be found in various fields of Physics, ranging from Decay Chains in Nuclear Reactions to the problem regarding the Harmonic Oscillator in Quantum Mechanics. Linear ODEs of higher order can be converted into a set of first order differential equations. Thus the motivation for solving Linear ODEs. Often, it is difficult to solve even these analytically, and they must be solved numerically.

Linear Ordinary Differential Equations can be solved by various methods such as Euler's methods, solution by way of taking Taylor series expansions and the Runge-Kutta methods among others.

I propose to deal with some of the methods of solving Linear ODEs and provide a comparison of the different methods in this project. Perhaps I could restrict myself to the different methods that fall under the category of Runge-Kutta (RK) methods, that is, study the solution of Linear ODEs using the RK methods of different orders and the embedded RK methods, which also provide the errors.

The study would deal with the time scales related to the different methods used and also compare the accuracy of the methods. A comparison could also be made for higher order Linear ODEs and how the different methods tackle them. The project might shed light on the method of solving Linear ODEs that should be selected to optimize the result keeping in mind the time constraints, the desired

accuracy and the complexity of the problem at hand. I would personally gain some insight into the different methods of solving Linear ODEs numerically as a benefit from this project.