Runge-Kutta Method

A method of numerically integrating ordinary differential equations by using a trial step at the midpoint of an interval to cancel out lower-order error terms. The second-order formula is

$$k_1 = h\,f\,(x_n,\,y_n) \tag{1}$$

$$k_2 = h\,f\left(x_n + \tfrac{1}{2}\,h,\,y_n + \tfrac{1}{2}\,k_1\right) \tag{2}$$

$$y_{n+1} = y_n + k_2 + O\!\left(h^3\right) \tag{3}$$

(where $O\,(x)$ is a Landau symbol), sometimes known as RK2, and the fourth-order formula is

$$k_1 = h\,f\,(x_n,\,y_n) \tag{4}$$

$$k_2 = h\,f\left(x_n + \tfrac{1}{2}\,h,\,y_n + \tfrac{1}{2}\,k_1\right) \tag{5}$$

$$k_3 = h\,f\left(x_n + \tfrac{1}{2}\,h,\,y_n + \tfrac{1}{2}\,k_2\right) \tag{6}$$

$$k_4 = h\,f\,(x_n + h,\,y_n + k_3) \tag{7}$$

Runge Kutta Method Example Solution

John Ll Morris

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   Numerical Methods with Worked Examples Chris Woodford,C. Woodford,Chris Phillips,1997-08-31 This book is for students following a module in numerical methods numerical techniques or numerical analysis It approaches the subject from a pragmatic viewpoint appropriate for the modern student The theory is kept to a minimum commensurate with comprehensive coverage of the subject and it contains abundant worked examples which provide easy understanding through a clear and concise theoretical treatment   *Fundamentals of Engineering Numerical Analysis* Parviz Moin,2010-08-23 In this work Parviz Moin introduces numerical methods and shows how to develop analyse and use them A thorough and practical text it is intended as a first course in numerical analysis   **Numerical Methods for Engineers and Scientists Using MATLAB®** Ramin S. Esfandiari,2017-04-25 This book provides a pragmatic methodical and easy to follow presentation of numerical methods and their effective implementation using MATLAB which is introduced at the outset The author introduces techniques for solving equations of a single variable and systems of equations followed by curve fitting and interpolation of data The book also provides detailed coverage of numerical differentiation and integration as well as numerical solutions of initial value and boundary value problems The author then presents the numerical solution of the matrix eigenvalue problem which entails approximation of a few or all eigenvalues of a matrix The last chapter is devoted to numerical solutions of partial differential equations that arise in engineering and science Each method is accompanied by at least one fully worked out example showing essential details involved in preliminary hand calculations as well as computations in MATLAB   **Ordinary Differential Equations** Charles Roberts,2011-06-13 In the traditional curriculum students rarely study nonlinear differential equations and nonlinear systems due to the difficulty or impossibility of computing explicit solutions manually Although the theory associated with nonlinear systems is advanced generating a numerical solution with a computer and interpreting that solution are fairly elementary Bringing the computer into the classroom Ordinary Differential Equations Applications Models and Computing emphasizes the use of computer software in teaching differential equations Providing an even balance between theory computer solution and application the text discusses the theorems and applications of the first order initial value problem including learning theory models population growth models epidemic models and chemical reactions It then examines the theory for n th order linear differential equations and the Laplace transform and its properties before addressing several linear differential equations with constant coefficients that arise in physical and electrical systems The author also presents systems of first order differential equations as well as linear systems with constant coefficients that arise in physical systems such as coupled spring mass systems pendulum systems the path of an electron and mixture problems The final chapter introduces techniques for determining the behavior of solutions to systems of first order differential equations without first finding the solutions Designed to be independent of any particular software package the book includes a CD ROM with the software used to generate the

solutions and graphs for the examples The appendices contain complete instructions for running the software A solutions manual is available for qualifying instructors   Practical MATLAB Modeling with Simulink Sulaymon L. Eshkabilov,2020-04-07 Employ the essential and hands on tools and functions of MATLAB s ordinary differential equation ODE and partial differential equation PDE packages which are explained and demonstrated via interactive examples and case studies This book contains dozens of simulations and solved problems via m files scripts and Simulink models which help you to learn programming and modeling of more difficult complex problems that involve the use of ODEs and PDEs You ll become efficient with many of the built in tools and functions of MATLAB Simulink while solving more complex engineering and scientific computing problems that require and use differential equations Practical MATLAB Modeling with Simulink explains various practical issues of programming and modelling After reading and using this book you ll be proficient at using MATLAB and applying the source code from the book s examples as templates for your own projects in data science or engineering What You Will Learn Model complex problems using MATLAB and Simulink Gain the programming and modeling essentials of MATLAB using ODEs and PDEs Use numerical methods to solve 1st and 2nd order ODEs Solve stiff higher order coupled and implicit ODEs Employ numerical methods to solve 1st and 2nd order linear PDEs Solve stiff higher order coupled and implicit PDEs Who This Book Is For Engineers programmers data scientists and students majoring in engineering applied industrial math data science and scientific computing This book continues where Apress Beginning MATLAB and Simulink leaves off   **A First Course in Numerical Analysis** Anthony Ralston,Philip Rabinowitz,2001-01-01 Outstanding text oriented toward computer solutions stresses errors in methods and computational efficiency Problems some strictly mathematical others requiring a computer appear at the end of each chapter   **Advanced Mathematics for Practicing Engineers** Kurt Arbenz,Alfred Wohlhauser,1986 Very Good No Highlights or Markup all pages are intact   Methods for Solutions of Nonlinear Ordinary Differential Equations, Applications Demetrios G. Magiros,1968   **Numerical Methods for Engineers and Scientists** Amos Gilat,Vish Subramaniam,2008 Following a unique approach this innovative book integrates the learning of numerical methods with practicing computer programming and using software tools in applications It covers the fundamentals while emphasizing the most essential methods throughout the pages Readers are also given the opportunity to enhance their programming skills using MATLAB to implement algorithms They ll discover how to use this tool to solve problems in science and engineering   **Numerical Mathematical Analysis** James Blaine Scarborough,1930   **Circuit Analysis with Computer Application to Problem Solving** Someshwar Chander Gupta,Jon W. Bayliss,Behrouz Peikari,1977   Numerical Methods with Fortran 77 Laurence V. Atkinson,Laurence Atkinson,P. J. Harley,J. D. Hudson (Ph. D.),1989   **A Numerical Solution for the Transient Strain Distribution in a Rectangular Plate with a Propagating Crack** Michael Paul Gaus,1959   **Computational Methods in Elementary Numerical Analysis** John Ll Morris,1983   *Numerical Techniques for Chemical and Biological Engineers Using MATLAB®* Said S.E.H. Elnashaie,Frank Uhlig,Chadia

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