



THE HONG KONG UNIVERSITY OF SCIENCE & TECHNOLOGY

Department of Mathematics

SEMINAR ON SCIENTIFIC COMPUTATION

**A fourth-order conservative semi-Lagrangian finite volume WENO scheme
without operator splitting for kinetic and fluid simulations**

by

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Abstract

In this presentation, we present a fourth-order conservative semi-Lagrangian (SL) finite volume (FV) weighted essentially non-oscillatory (WENO) scheme without operator splitting for two-dimensional linear transport equations with applications of kinetic models including the nonlinear Vlasov-Poisson system, the guiding center Vlasov model and the incompressible Euler equation in the vorticity-stream function formulation. To achieve fourth-order accuracy in space, two main ingredients are proposed in the SL FV formulation. Firstly, we introduce a so-called cubic-curved quadrilateral upstream cell and applying an efficient clipping method to evaluate integrals on upstream cells. Secondly, we construct a new WENO reconstruction operator, which recovers a P3 polynomial from neighboring cell averages. Mass conservation is accomplished with the mass conservative nature of the reconstruction operator and the SL formulation. A positivity-preserving limiter is applied to maintain the positivity of the numerical solution wherever appropriate. For nonlinear kinetic models, the SL scheme is coupled with a fourth-order Runge-Kutta exponential integrator for high-order temporal accuracy. Extensive bench marks are tested to verify the designed properties.

Date : 31 May 2023 (Wednesday)

Time : 4:00pm – 5:00pm

Venue : Room 5510 (Lifts 25/26)

All are Welcome!

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Seminar on Scientific Computation, November 1949 Cuthbert Corwin Hurd, Franklin Institute (Philadelphia, Pa.). Library, International Business Machines Corporation, 1950 **Selected Papers from the Second Conference on Parallel**

Processing for Scientific Computing Charles William Gear, Robert G. Voigt, 1987-01-01 Proceedings Parallel Computing

Monte Carlo Methods Malvin H. Kalos, Paula A. Whitlock, 2009-06-10 This introduction to Monte Carlo methods seeks to identify and study the unifying elements that underlie their effective application Initial chapters provide a short treatment of the probability and statistics needed as background enabling those without experience in Monte Carlo techniques to apply these ideas to their research The book focuses on two basic themes The first is the importance of random walks as they occur both in natural stochastic systems and in their relationship to integral and differential equations The second theme is that of variance reduction in general and importance sampling in particular as a technique for efficient use of the methods Random walks are introduced with an elementary example in which the modeling of radiation transport arises directly from a schematic probabilistic description of the interaction of radiation with matter Building on this example the relationship between random walks and integral equations is outlined The applicability of these ideas to other problems is shown by a clear and elementary introduction to the solution of the Schrödinger equation by random walks The text includes sample problems that readers can solve by themselves to illustrate the content of each chapter This is the second completely revised and extended edition of the successful monograph which brings the treatment up to date and incorporates the many advances in Monte Carlo techniques and their applications while retaining the original elementary but general approach

Modern Mathematics for the Engineer: First Series Edwin F. Beckenbach, 2013-09-03 This volume and its successor focus on material relevant to solving mathematical problems regularly confronted by engineers Volume One's three part treatment covers mathematical models probabilistic problems and computational considerations 1956 edition *Predicting the Winner* Ira Chinoy, 2024-05 Winner of the Ray Hiebert History of Journalism Published Work Award The history of American elections changed profoundly on the night of November 4 1952 An outside the box approach to predicting winners from early returns with new tools computers was launched live and untested on the newest medium for news television Like exhibits in a freak show computers were referred to as electronic brains and mechanical monsters Yet this innovation would help fuel an obsession with numbers as a way of understanding and shaping politics It would engender controversy down to our own time And it would herald a future in which the public square would go digital The gamble was fueled by a crisis of credibility stemming from faulty election night forecasts four years earlier in 1948 combined with a lackluster presentation of returns What transpired in 1952 is a complex tale of responses to innovation which Ira Chinoy makes understandable via a surprising history of election nights as venues for rolling out new technologies refining methods of prediction and providing opportunities for news organizations to shine In *Predicting the Winner* Chinoy tells in detail for the first time the story of the

1952 election night a night with continuing implications for the way forward from the dramatic events of 2020 21 and for future election nights in the United States *The Computer from Pascal to von Neumann* Herman H. Goldstine, 2008-09-02

In 1942 Lt Herman H Goldstine a former mathematics professor was stationed at the Moore School of Electrical Engineering at the University of Pennsylvania It was there that he assisted in the creation of the ENIAC the first electronic digital computer The ENIAC was operational in 1945 but plans for a new computer were already underway The principal source of ideas for the new computer was John von Neumann who became Goldstine s chief collaborator Together they developed EDVAC successor to ENIAC After World War II at the Institute for Advanced Study they built what was to become the prototype of the present day computer Herman Goldstine writes as both historian and scientist in this first examination of the development of computing machinery from the seventeenth century through the early 1950s His personal involvement lends a special authenticity to his narrative as he sprinkles anecdotes and stories liberally through his text *Mathematical Methods of Operations Research* Thomas L. Saaty, 2004-01-01 The first graduate level text devoted to the subject this classic offers a concise history and overview of methods as well as an excellent exposition of the mathematical foundations underlying classical operations research procedures It begins with a review of historical scientific and mathematical aspects examples and ideas related to classical methods of forming models introduce discussions of optimization game theory applications of probability and queuing theory Carefully selected exercises illustrate important and useful ideas This text is an ideal introduction for students to the basic mathematics of operations research as well as a valuable source of references to early literature on operations research 1959 edition *Monte Carlo* George Fishman, 2013-03-09 This book provides an introduction to the Monte Carlo method suitable for a one or two semester course for graduate and advanced undergraduate students in the mathematical and engineering sciences It also can serve as a reference for the professional analyst In the past my inability to provide students with a single source book on this topic for class and for later professional reference had left me repeatedly frustrated and eventually motivated me to write this book In addition to focused accounts of major topics the book has two unifying themes One concerns the effective use of information and the other concerns error control and reduction The book describes how to incorporate information about a problem into a sampling plan in a way that reduces the cost of estimating its solution to within a specified error bound Although exploiting special structures to reduce cost long has been a hallmark of the Monte Carlo method the propensity of users of the method to discard useful information because it does not fit traditional textbook models repeatedly has impressed me The present account aims at reducing the impediments to integrating this information Errors both statistical and computational abound in every Monte Carlo sampling experiment and a considerable methodology exists for controlling them *Computerworld* , 1986-10-27 For more than 40 years Computerworld has been the leading source of technology news and information for IT influencers worldwide Computerworld s award winning Web site Computerworld.com twice monthly publication focused conference series and custom research

form the hub of the world's largest global IT media network **Nuclear Science Abstracts** ,1973 Future Energy Conferences and Symposia ,1994 *Bibliography on the Use of IBM Machines in Science, Statistics, and Education* Watson Scientific Computing Laboratory,1954 **The Origins of Digital Computers** B. Randell,2012-12-06 My interest in the history of digital computers became an active one when I had the fortune to come across the almost entirely forgotten work of PERCY LUDGATE who designed a mechanical program controlled computer in Ireland in the early 1940s I undertook an investigation of his life and work during which I began to realise that a large number of early developments which we can now see as culminating in the modern digital computer had been most undeservedly forgotten Hopefully historians of science some of whom are now taking up the subject of the development of the computer and accumulating valuable data particularly about the more recent events from the people concerned will before too long provide us with comprehensive analytical accounts of the invention of the computer The present book merely aims to bring together some of the more important and interesting written source material for such a history of computers Where necessary papers have been translated into English but every attempt has been made to retain the flavour of the original and to avoid possibly misleading use of modern computing terminology **Newsletter** University of Michigan Computing Center,1980 Numerical Methods of Reactor Analysis Melville Jr. Clark,2012-12-02 *Nuclear Science and Technology Volume 3 Numerical Methods of Reactor Analysis* presents the numerical analysis frequently used in the nuclear reactor field This book discusses the numerical approximation for the multigroup diffusion method which results in simple algebraic equations Organized into six chapters this volume starts with an overview of the simplified formulation of linear algebra by defining the matrices and operations with matrices This text then discusses the properties of special matrices and reviews the elementary properties of finite difference equations Other chapters consider a variety of methods of obtaining numerical solutions to the approximating equations The final chapter deals with Monte Carlo method which is a statistical method for solving statistical or deterministic problems This book is a valuable resource for nuclear engineers Students at the graduate level who had an introductory course in reactor physics and a basic course in differential equations will also find this book useful *NBS-INA, the Institute for Numerical Analysis, UCLA 1947-1954* Magnus Rudolph Hestenes,1991 *Proceedings of the Annual Statistical Engineering Symposium* United States. Army. Chemical Corps. Engineering Agency,1955 **Proceedings, Seminar on Scientific Computation, November, 1949** International Business Machines Corporation,1950 *Boundary Value Problems of Heat Conduction* M. Necati Ozisik,2002-01-01 Intended for first year graduate courses in heat transfer including topics relevant to aerospace engineering and chemical and nuclear engineering this hardcover book deals systematically and comprehensively with modern mathematical methods of solving problems in heat conduction and diffusion Includes illustrative examples and problems plus helpful appendixes 134 illustrations 1968 edition *Bulletin* ,1978

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