Data Driven Fluid Simulations Using Regression Forests

Mathematical Theory of Compressible Fluid Flow
On the Data-driven Reduced Order Modelling in Fluid Dynamics
Automatically Distributing and Load Balancing Graphical Fluid Simulations
Simulation of Fluid Flows Based on the Data-driven Evolution of Vortex Particles
Example-Based Fluid Simulation
Deep Learning for Fluid Simulation and Animation
Parallel, Data-Driven Simulation and Visualization of the Heart
Data-driven Modeling and Process Intensification for Sustainable Chemical Manufacturing
Machine Learning Based Data-driven Methods for Modelling and Simulation of Pressure Dynamics and Fluid Flow in Natural Gas Reservoirs
Adaptive Fluid Simulation Using a Linear Octree Structure
Determining Unknown Boundary Conditions in Fluid-Thermal Systems Using the Dynamic Data Driven Application Systems Methodology
Data-Driven Modeling & Scientific Computation
The Finite Volume Method in Computational Fluid Dynamics
Algorithms, Data-driven Methods and Analysis in Fluid Dynamics and Fluid-Structure Interactions
Data Analysis for Direct Numerical Simulations of Turbulent Combustion
Modeling in Engineering Using Innovative Numerical Methods for Solids and Fluids
Data-Driven Fluid Mechanics
Virtual and Mixed Reality
Smart Proxy Modeling
Direct Numerical Simulations of Gas–Liquid Multiphase Flows
Hybrid and Data-driven Methods for Efficient and Realistic Particle-based Liquid Simulations
Data Driven Analysis and Modeling of Turbulent Flows
The Art of Fluid Animation
Data-Driven Fluid Mechanics
Data-Driven Science and Engineering
Dynamic Mode Decomposition
Deep Data-driven Modeling and Control of High-dimensional Nonlinear Systems
High Performance Simulation for Industrial Paint Shop Applications
Micro- and Nanoscale Fluid Mechanics
Guide to Dynamic Simulations of Rigid Bodies and Particle Systems
Computational and Experimental Simulations in Engineering
Data Analysis for Direct Numerical Simulations of Turbulent Combustion
Fluid Simulation for Computer Graphics
Real-time Rendering of Data-driven Fluid Simulations with Style Transfer
Fluid Engine Development
An Introduction to Reservoir Simulation Using MATLAB/GNU Octave
Numerical Simulation in Fluid Dynamics
Computational Fluid Dynamics
Analysis Supported SPH Fluid Simulation
Turbulence

CAMACHO VANESSA

Mathematical Theory of Compressible Fluid Flow Springer Nature
The approximation of natural phenomena such as liquid simulations in computer graphics requires complex methods that are computationally expensive. Despite recent advances in this field, the gap in realism between a simulated liquid and reality remains considerable. This disparity that separates us from the desired realism requires numerical models whose complexity continues to grow. The ultimate goal is to provide users the capacity and tools to manipulate these liquid simulation models to obtain acceptable realism. In the last decade, several approaches have been revisited to simplify and to allow more flexible models. In this dissertation by articles, we present three projects whose contributions support the improvement and flexibility of generating liquid simulations for computer graphics. First, we introduce a hybrid approach allowing us to separately process the volume of non-apparent liquid (i.e., in-depth) and a band of surface particles using the Smoothed Particle Hydrodynamics (SPH) method. We revisit the particle band approach, but this time newly applied to the SPH method, which offers a higher level of realism. Then, as a second project, we propose an approach to improve the level of detail of splashing liquids. By upsampling an existing liquid simulation, our approach is capable of generating realistic splash details through ballistic dynamics. In addition, we propose a wave simulation method to reproduce the interactions between the generated splashes and the quasi-static portions of the existing liquid simulation. Finally, the third project introduces an approach to enhance the apparent resolution of liquids through machine learning. We propose a learning architecture inspired by optical flows by which we generate a correspondence between the displacement of the particles of liquid simulations at different resolutions (i.e., low and high resolutions). Our training model allows high-resolution features to be encoded using pre-computed

deformations between two liquids at different resolutions and convolution operations based on the neighborhood of the particles.
On the Data-driven Reduced Order Modelling in Fluid Dynamics Cambridge University Press
Accurately predicting the behaviour of multiphase flows is a problem of immense industrial and scientific interest. Modern computers can now study the dynamics in great detail and these simulations yield unprecedented insight. This book provides a comprehensive introduction to direct numerical simulations of multiphase flows for researchers and graduate students. After a brief overview of the context and history the authors review the governing equations. A particular emphasis is placed on the 'one-fluid' formulation where a single set of equations is used to describe the entire flow field and interface terms are included as singularity distributions. Several applications are discussed, showing how direct numerical simulations have helped researchers advance both our understanding and our ability to make predictions. The final chapter gives an overview of recent studies of flows with relatively complex physics, such as mass transfer and chemical reactions, solidification and boiling, and includes extensive references to current work.
Automatically Distributing and Load Balancing Graphical Fluid Simulations Cambridge University Press
A practical introduction, the second edition of Fluid Simulation for Computer Graphics shows you how to animate fully three-dimensional incompressible flow. It covers all the aspects of fluid simulation, from the mathematics and algorithms to implementation, while making revisions and updates to reflect changes in the field since the first edition. Highlights of the Second Edition New chapters on level sets and vortex methods Emphasizes hybrid particle–voxel methods, now the industry standard approach Covers the latest algorithms and techniques, including: fluid surface reconstruction from particles; accurate, viscous free surfaces for buckling, coiling, and rotating liquids; and enhanced turbulence for smoke animation Adds new discussions on meshing, particles, and vortex methods The book changes the order of topics as they appeared in the first edition to make more sense when reading the first time through. It also contains several updates by distilling author Robert Bridson’s experience in the visual effects industry to highlight the most important points in fluid simulation. It gives you an understanding of how the components of fluid simulation work as well as the tools for creating your own animations.
Simulation of Fluid Flows Based on the Data-driven Evolution of Vortex Particles Cambridge University Press
The 13th International Conference on Human–Computer Interaction, HCI International 2009, was held in San Diego, California, USA, July 19–24, 2009, jointly with the Symposium on Human Interface (Japan) 2009, the 8th International Conference on Engineering Psychology and Cognitive Ergonomics, the 5th International Conference on Universal Access in Human–Computer Interaction, the Third International Conf- ence on Virtual and Mixed Reality, the Third International Conference on Internationalization, Design and Global Development, the Third International Conference on Online Communities and Social Computing, the 5th International Conference on Augmented Cognition, the Second International Conference on Digital Human Mod- ing, and the First International Conference on Human Centered Design. A total of 4,348 individuals from academia, research institutes, industry and gove- mental agencies from 73 countries submitted contributions, and 1,397 papers that were judged to be of high scientific quality were included in the program. These papers - dress the latest research and development efforts and highlight the human aspects of the design and use of computing systems. The papers accepted for presentation thoroughly cover the entire field of human–computer interaction, addressing major advances in knowledge and effective use of computers in a variety of application areas.
Example-Based Fluid Simulation SIAM
This is the first book dedicated to data-driven methods for fluid dynamics, with applications in analysis, modeling, control, and closures.
Deep Learning for Fluid Simulation and Animation CRC Press
Presents numerical methods for reservoir simulation, with efficient implementation and examples using widely-used online open-source code, for researchers, professionals and advanced students. This title is also available as Open Access on Cambridge Core.
Parallel, Data-Driven Simulation and Visualization of the Heart Cambridge University Press
This book presents techniques for creating fluid-like animations with no required advanced physics and mathematical skills. It describes how to create fluid animations like water, smoke, fire, and explosions through computer code in a fun manner. It includes a historical background of the computation of fluids as well as concepts that drive fluid animations, and also provides computer code that readers can download and run on several platforms to create their own programs using fluid animation.
Data-driven Modeling and Process Intensification for Sustainable Chemical Manufacturing CRC Press
Second, we model liquid-liquid microflow systems. We employ a state-of-the-art algorithm in computational fluid dynamics (CFD) simulations to study flow patterns, extraction, and mass transport in biphasic microreactors. The convective and diffusive contributions to the mass transfer of different flow patterns are analyzed. Moreover, we build a machine learning model to predict the flow patterns accurately and identify critical features for design.
Machine Learning Based Data-driven Methods for Modelling and Simulation of Pressure Dynamics and Fluid Flow in Natural Gas Reservoirs Cambridge University Press
In this translation of the German edition, the authors provide insight into the numerical simulation of fluid flow. Using a simple numerical method as an expository example, the individual steps of scientific computing are presented: the derivation of the mathematical model; the discretization of the model equations; the development of algorithms; parallelization; and visualization of the computed data. In addition to the treatment of the basic equations for modeling laminar, transient flow of viscous, incompressible fluids - the Navier-Stokes equations - the authors look at the simulation of free surface flows; energy and chemical transport; and turbulence. Readers are enabled to write their own flow simulation program from scratch. The variety of applications is shown in several simulation results, including 92 black-and-white and 18 color illustrations. After reading this book, readers should be able to understand more enhanced algorithms of computational fluid dynamics and apply their new knowledge to other scientific fields.
Adaptive Fluid Simulation Using a Linear Octree Structure CRC Press
The book examines innovative numerical methods for computational solid and fluid mechanics that can be used to model complex problems in engineering. It also presents innovative and promising simulation methods, including the fundamentals of these methods, as well as advanced topics and complex applications. Further, the book explores how numerical

simulations can significantly reduce the number of time-consuming and expensive experiments required, and can support engineering decisions by providing data that would be very difficult, if not impossible, to obtain experimentally. It also includes chapters covering topics such as particle methods addressing particle-based materials and numerical methods that are based on discrete element formulations; fictitious domain methods; phase field models; computational fluid dynamics based on modern finite volume schemes; hybridizable discontinuous Galerkin methods; and non-intrusive coupling methods for structural models.
Determining Unknown Boundary Conditions in Fluid-Thermal Systems Using the Dynamic Data Driven Application Systems Methodology Springer Science & Business Media
In many engineering applications involving fluid-thermal systems, detailed quantitative information on the flow, temperature, and species concentration is needed for system optimization. Numerical simulation can obtain the desired information and thus optimize the system. However, this approach requires well-defined boundary and operating conditions which may not be completely known due to limited access for experimental measurements. The objective of our research is to develop a Dynamic Data Driven Applications System approach that synergizes experiment and simulation to determine the boundary and operating conditions, thereby achieving a full simulation capability. Regarding the heated wall jet in the crossflow problem, the objective is to determine the met inflow conditions using a Dynamic Data Driven Applications Systems method that synergizes experiment and simulation.
Data-Driven Modeling & Scientific Computation Springer
A textbook covering data-science and machine learning methods for modelling and control in engineering and science, with Python and MATLAB®.
The Finite Volume Method in Computational Fluid Dynamics Academic Press
This book gathers the latest advances, innovations, and applications in the field of computational engineering, as presented by leading international researchers and engineers at the 26th International Conference on Computational & Experimental Engineering and Sciences (ICCES), held in Phuket, Thailand on January 6-10, 2021. ICCES covers all aspects of applied sciences and engineering: theoretical, analytical, computational, and experimental studies and solutions of problems in the physical, chemical, biological, mechanical, electrical, and mathematical sciences. As such, the book discusses highly diverse topics, including composites; bioengineering & biomechanics; geotechnical engineering; offshore & arctic engineering; multi-scale & multi-physics fluid engineering; structural integrity & longevity; materials design & simulation; and computer modeling methods in engineering. The contributions, which were selected by means of a rigorous international peer-review process, highlight numerous exciting ideas that will spur novel research directions and foster multidisciplinary collaborations.
Algorithms, Data-driven Methods and Analysis in Fluid Dynamics and Fluid-Structure Interactions Springer Nature
Numerical simulation models are used in all engineering disciplines for modeling physical phenomena to learn how the phenomena work, and to identify problems and optimize behavior. Smart Proxy Models provide an opportunity to replicate numerical simulations with very high accuracy and can be run on a laptop within a few minutes, thereby simplifying the use of complex numerical simulations, which can otherwise take tens of hours. This book focuses on Smart Proxy Modeling and provides readers with all the essential details on how to develop Smart Proxy Models using Artificial Intelligence and Machine Learning, as well as how it may be used in real-world cases. Covers replication of highly accurate numerical simulations using Artificial Intelligence and Machine Learning Details application in reservoir simulation and modeling and computational fluid dynamics Includes real case studies based on commercially available simulators Smart Proxy Modeling is ideal for petroleum, chemical, environmental, and mechanical engineers, as well as statisticians and others working with applications of data-driven analytics.
Data Analysis for Direct Numerical Simulations of Turbulent Combustion Springer Nature
This book provides an introduction, overview, and specific examples of computational fluid dynamics and their applications in the water, wastewater, and stormwater industry.
Modeling in Engineering Using Innovative Numerical Methods for Solids and Fluids Springer
Data-driven methods have become an essential part of the methodological portfolio of fluid dynamicists, motivating students and practitioners to gather practical knowledge from a diverse range of disciplines. These fields include computer science, statistics, optimization, signal processing, pattern recognition, nonlinear dynamics, and control. Fluid mechanics is historically a big data field and offers a fertile ground for developing and applying data-driven methods, while also providing valuable shortcuts, constraints, and interpretations based on its powerful connections to basic physics. Thus, hybrid approaches that leverage both methods based on data as well as fundamental principles are the focus of active and exciting research. Originating from a one-week lecture series course by the von Karman Institute for Fluid Dynamics, this book presents an overview and a pedagogical treatment of some of the data-driven and machine learning tools that are leading research advancements in model-order reduction, system identification, flow control, and data-driven turbulence closures.
Data-Driven Fluid Mechanics Springer Science & Business Media
A pioneer in the fields of statistics and probability theory, Richard von Mises (1883–1953) made notable advances in boundary-layer-flow theory and airfoil design. This text on compressible flow, unfinished upon his sudden death, was subsequently completed in accordance with his plans, and von Mises' first three chapters were augmented with a survey of the theory of steady plane flow. Suitable as a text for advanced undergraduate and graduate students — as well as a reference for professionals — Mathematical Theory of Compressible Fluid Flow examines the fundamentals of high-speed flows, with detailed considerations of general theorems, conservation equations, waves, shocks, and nonisentropic flows. In this, the final work of his distinguished career, von Mises summarizes his extensive knowledge of a central branch of fluid mechanics. Characteristically, he pays particular attention to the basics, both conceptual and mathematical. The novel concept of a specifying equation clarifies the role of thermodynamics in the mechanics of compressible fluids. The general theory of characteristics receives a remarkably complete and simple treatment, with detailed applications, and the theory of shocks as asymptotic phenomena appears within the context of rational mechanics.
Virtual and Mixed Reality Cambridge University Press
Smoothed Particle Hydrodynamics (SPH) is a mesh-free method that has been widely used in several fields such as astrophysics, solids mechanics, and fluid dynamics. This computational fluid dynamics model has

been extensively studied and is mature enough to enable detailed quantitative comparisons with laboratory experiments. Therefore, understanding and revealing the underneath behaviors of SPH fluid simulation becomes more meaningful when SPH is used to help us understand similar phenomena in the real world. In the thesis, we use the Finite Time Lyapunov Exponent (FTLE) and a novel rotation metric as well as other analysis methods to analyze the SPH. First of all, we modify traditional FTLE by using Moving Least Squares to calculate the deformation matrix, and extend the usage from mesh-based to mesh-free data sets; we are the first to apply FTLE on free surface SPH fluid simulation. In addition, we are the first to apply rotation sum and gradient of rotation sum on particles based fluid simulation. We present a new way of using Moving Least Squares to calculate the gradient of rotation sum for mesh-free data sets. What's more, we are the first to apply asymmetric tensor field analysis on particle based fluid simulation. Furthermore, we utilize a number of visualization techniques on different analysis results. We present why choosing a proper visualization is crucial to reveal useful information, and we also demonstrate how to utilize transfer functions to decrease perturbations of data sets. Lastly, we compare different analysis results, such as FTLE versus gradient of rotation sum. Our methods are also useful to enhance the rendering of SPH simulation results, which reveals many small-scale detailed flow behaviors that would not be seen using existing rendering approaches. Our results are more realistic in terms of revealing the underneath behaviors of fluid simulation.

Smart Proxy Modeling SIAM

This book describes the current state of the art for simulating paint shop applications, their advantages and limitations, as well as corresponding high-performance computing (HPC) methods utilized in this domain. The authors provide a comprehensive introduction to fluid simulations, corresponding optimization methods from the HPC domain, as well as industrial paint shop applications. They showcase how the complexity of these applications bring corresponding fluid simulation methods to their limits and how these shortcomings can be overcome by employing HPC methods. To that end, this book covers various optimization techniques for three individual fluid simulation techniques, namely grid-based methods, volumetric decomposition methods, and particle-based methods.

Direct Numerical Simulations of Gas–Liquid Multiphase Flows Courier Corporation

From the splash of breaking waves to turbulent swirling smoke, the mathematical dynamics of fluids are varied and continue to be one of the most challenging aspects in animation. Fluid Engine Development demonstrates how to create a working fluid engine through the use of particles and grids, and even a combination of the two. Core algorithms are explained from a developer’s perspective in a practical, approachable way that will not overwhelm readers. The Code Repository offers further opportunity for growth and discussion with continuously changing content and source codes. This book helps to serve as the ultimate guide to navigating complex fluid animation and development. Explains how to create a fluid simulation engine from scratch Offers an approach that is code-oriented rather than math-oriented, allowing readers to learn how fluid dynamics works with code, with downloadable code available Explores various kinds of simulation techniques for fluids using particles and grids Discusses practical issues such as data structure design and optimizations Covers core numerical tools including linear system and level set solvers