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Carlos Alberto Dutra Fraga Filho

Reflective Boundary Conditions in SPH Fluid Dynamics Simulation

Two and Three-dimensional Validation and Applications

Springer

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Thine eyes did see my substance, yet being unperfect; and in thy book all my members were written, which in continuance were fashioned, when as yet there was none of them.

Psalm 139:16 KJV

This book is dedicated to all the people (professors, students, researchers and collaborators) who have followed the implementation of reflective boundary conditions in particle simulation since the beginning of the author's research work. Furthermore, I dedicate it to God, who granted me the health and wisdom to produce it in times of scarce research and scientific dissemination support.

Preface

This book provides a synopsis of the efforts to implement and validate the physical reflective boundary technique coupled with Lagrangian particle modelling in continuum mechanics. In addition to the physics theory that justifies the use of the reflective technique in the continuous domain, it was essential to demonstrate that the implementation of this technique was feasible in the computational realm.

The characteristics of Lagrangian particle modelling, which provide the input data for the collision detection and response algorithm (the tool used to implement reflective boundary conditions computationally), are not the main focus of this work; however, the reader is provided with bibliographical references on particle modelling used in each case study in this book.

The first implementations in two-dimensional domains occurred about ten years ago. As the numerical results were validated, new implementations were carried out until the collision detection and response algorithm was possible to deal with collisions between particles and solid contours in three-dimensional domains.

This work's scientific contribution lies in compiling and synthesising the implementation's reflective boundary conditions and the validation stages for some relevant and well-known hydrodynamics and hydrostatics problems, which were historically solved using artificial boundary treatment techniques.

Vitória, Brazil
July 2024

Carlos Alberto Dutra Fraga Filho

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About the Author

Carlos Alberto Dutra Fraga Filho is a Brazilian professor and researcher. He holds the following degrees: undergraduate in Mechanical Engineering (1998), Master of Science in Mechanical Engineering (2007), and Ph.D. in Environmental Engineering (2014). He has experience in the mechanical and environmental engineering fields, with an emphasis on Computational Fluid Dynamics and Transport Phenomena. Fraga Filho is a Journals' Reviewer: *Physics of Fluids* (American Institute of Physics), *Journal of the Brazilian Society of Mechanical Sciences and Engineering*, and *Advances in Water Resources*, and has two books—*Smoothed Particle Hydrodynamics: Fundamentals and Basic Applications in Continuum Mechanics* (https://doi.org/10.1007/978-3-030-00773-7) and *Dynamic Analysis of Composite Materials (FGM) via Finite Elements: Numerical Simulation and Experimental Validation* (ISBN-10: 6202043490)—and diverse scientific papers published.