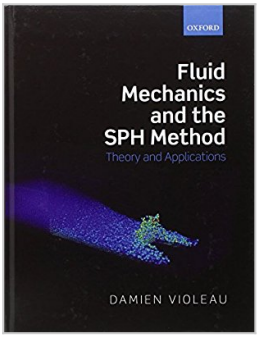

Fluid Mechanics and the SPH Method: Theory and Applications

By Damien Violeau

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This book presents the SPH method (Smoothed-Particle Hydrodynamics) for fluid modelling from a theoretical and applied viewpoint. It comprises two parts that refer to each other. The first one, dealing with the fundamentals of Hydraulics, is based on the elementary principles of Lagrangian and Hamiltonian Mechanics. The specific laws governing a system of macroscopic particles are built, before large systems involving dissipative processes are explained. The continua are discussed, and a fairly exhaustive account of turbulence is given. The second part discloses the bases of the SPH Lagrangian numerical method from the continuous equations, as well as from discrete variational principles, setting out the method's specific properties of conservativity and invariance. Various numerical schemes are compared, permanently referring to the physics as dealt with in the first part. Applications to schematic instances are discussed, and, ultimately, practical applications to the dimensioning of coastal and fluvial structures are considered.

Despite the rapid growth in the SPH field, this book is the first to present the method in a comprehensive way for fluids. It should serve as a rigorous introduction to SPH and a reference for fundamental mathematical fluid dynamics. This book is intended for scientists, doctoral students, teachers, and engineers, who want to enjoy a rather unified approach to the theoretical bases of Hydraulics or who want to improve their skills using the SPH method. It will inspire the reader with a feeling of unity, answering many questions without any detrimental formalism.

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Fluid Mechanics and the SPH Method: Theory and Applications By Damien Violeau Bibliography

- Sales Rank: #2274667 in Books
- Brand: Brand: Oxford University Press
- Published on: 2012-07-05
- Original language: English
- Number of items: 1
- Dimensions: 7.60" h x 1.50" w x 9.80" l, 2.90 pounds
- Binding: Hardcover
- 640 pages

Editorial Review

Review
"This is an unconventional, deep and broad-ranging treatment of mathematical fluid mechanics, leading to the development of SPH for complex engineering applications involving turbulent free-surface flow. The book is built on careful development of theory from Lagrangian, statistical and
variational principles, underpinned by strong physical reasoning. For graduate students in engineering and physics, particularly those with an interest in SPH, this will be a valuable reference, and there are fresh insights for the most expert reader."

--Nathan Quinlan, National University of Ireland Galway

"The book will serve as an invaluable guide and introduction to anyone interested in "how and why SPH works". This text will take them into the heart of the method to the most fundamental basic principles, and give them the definitive background on the technique. The book will be particularly
useful for graduate research students and practicing engineers. Furthermore, as SPH is now beginning to be part of university degree courses, this is possibly the only book that covers all the areas needed for further reading and study."

--Benedict Rogers, School of Mechanical, Aerospace and Civil Engineering, University of Manchester

About the Author

Damien Violeau graduated from Ecole des Ponts ParisTech, one of the major French engineering colleges, and currently works as 'Expert Researcher' at the National Hydraulics and Environment Laboratory of the R&D branch of EDF (Electricite de France). During 15 years of experience in engineering for waterworks and computational fluid dynamics, he has focused on the Lagrangian modelling of turbulent flows through the Smoothed Particle Hydrodynamics numerical method, SPH. He has also been acting as an organiser of the SPH international community through the working group SPHERIC (SPH European Research Interest Group).

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