



Fluid Mechanics and the SPH Method: Theory and Applications

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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