Preface

Additive manufacturing techniques have been rapidly growing and extensively adopted in various industrial sectors in the past decade. While experimentation is the dominant approach and has solved many problems in this field, computational modeling is becoming increasingly powerful, valuable and indispensable, from achieving fundamental understanding of complex problems to synergizing with hardware for next-generation intelligent additive manufacturing systems. Inspired by the classic books, e.g., "Additive manufacturing technologies" by Ian Gibson et al., we have been very eager to write this book specifically focused on computational modeling of additive manufacturing, after working in this area for more than 10 years. The major motivations are 1) to provide a comprehensive and up-to-date introduction on computational modeling of additive manufacturing, illustrating the power and value of computational modeling and thus benefiting both experimentalists and modelers; 2) to systematically describe the modeling approaches from the basic physics and governing equations, to the model implementation, simulation capability, and physical mechanisms obtained from simulation results, hopefully serving as a useful handbook for modelers from beginners to experts; 3) to summarize relevant research progresses in the past decade and share our reflections and outlooks for future directions in both academic research and industrial adoption.

Particularly, we hope that this book can promote the value of computational modeling in additive manufacturing to be better recognized and more efforts to be devoted. One common bias is "what can be understood via simulation can all be understood via experiments or fundamental theory, and what cannot be explained via experiments or fundamental theory cannot be understood via simulation either". In fact, there were many conflicting speculations or explanations purely based on experimental results or fundamental theory in additive manufacturing, which have been well solved via simulations, e.g., balling effect and pore formation. The insights from simulation certainly are understandable to researchers and align with fundamental theories, but this only happens after the insights are obtained from the simulation results. There are also some counter-