Preface

Liquid rocket engines are the main propulsion system for a spacecraft. The widespread applications of liquid rocket engines in the future demands further studies of combustion mechanisms in liquid rocket engines to improve their performance. Numerical modeling of the combustion process can improve our understanding of the incorporated physical mechanism and help in the design of liquid rocket engines. Since the 1970s, numerical simulations of combustion in liquid rocket engines have developed into a new interdisciplinary subject involving computational fluid dynamics, computational heat transfer, computational combustion, software design, and flow visualization. Owing to its significance in engine design, this new subject has attracted many researchers. With the rapid development of computer techniques and numerical methods, numerical modeling and simulations of atomization and combustion in liquid rocket engines will become an ever important research area.

The author has dedicated himself to the area of Aeronautical and Astronautical Science and technology since the 1980s. The present book is based on the teaching and supervision of undergraduate and postgraduate students in the past 30 years. The book highlights the advanced research work in the field of combustion modeling in liquid rocket engines, such as liquid propellant atomization, evaporation of liquid droplets, turbulent flows, turbulent combustion, heat transfer, and combustion instability. All these will contribute to our understanding of the combustion mechanism and to the improvement of combustion modeling, facilitating numerical simulations of combustion process in liquid fuelled engines.

The book consists of eight chapters. Chapter 1 describes the configuration and fundamentals of liquid rocket engines, and presents an overview of numerical simulations of combustion in liquid rocket engines. Chapters 2–7 detail the modeling of combustion sub processes in liquid rocket engines, i.e., atomization modeling, evaporation modeling, turbulence modeling, combustion modeling, heat transfer modeling, and combustion instability modeling. Chapter 8 presents a full description of numerical models for combustion, numerical methodology for governing equation solution, and grid generation. Finally, three applications are run to demonstrate the capability of the numerical models to predict the combustion process in liquid rocket engines.