Preface

The 11th International Colloquium on Pulsed and Continuous Detonations (ICPCD) continues a series of biannual international conferences started in 1998 from the first meeting in St. Petersburg. As a result of these conferences, several books have been published containing condensed papers and full manuscripts of selected papers. This volume includes the selected papers presented at ICPCD-2018 held in St. Petersburg. The book is dedicated to my teacher and colleague, Professor Anatolii Borisov whose contribution to the detonation physics is impressive and fundamental.

The book is organized with three Chapters: Transient Combustion Phenomena in Various Media (Chapter 1), Gaseous, Heterogeneous, and Condensed-Phase Detonations (Chapter 2), and Applications of Fast Combustion Modes and Detonations in Industry (Chapter 3).

Chapter 1: Transient Combustion Phenomena in Various Media

Sergeev et al. demonstrate that correct simulation of the spray autoignition process in a Diesel engine based on the detailed reaction mechanism requires careful temporal and spatial resolution of all autoignition stages (cool and blue flames, and hot explosion) in exothermic centers.

Quintens et al. apply ultrafast schlieren visualization of propagating cool flame and hot explosion to monitor the dynamics of the deflagration-to-detonation transition in the end-gas in the constant volume enclosure filled with the n-decane–air mixture.

Babuk et al. report the results of mathematical modeling of aluminum combustion in the burning solid propellant environment and indicate the pronounced differences between agglomerated and nonagglomerated metal burning.

Trofimov et al. present the qualitative thermodynamic analysis of detonation in cast trinitrotoluene postulating that the rate of shock-induced reaction in a condensed medium is determined not only by temperature but also by the strain rate of the medium.

Vlasenko et al. focus their computational study on the effect of the reaction mechanism, wall heat flux, and flow symmetry on combustion stabilization in the flow path of a high-speed ramjet and discuss the possible reasons for the multiplicity of steady-state solutions.

Chapter 2: Gaseous, Heterogeneous, and Condensed-Phase Detonations

Liu et al. study experimentally the effect of convergence on the cellular structure and propagation velocity of detonation in the stoichiometric acetylene–oxygen mixture at different initial pressures.

Levin et al. report the results of their numerical and experimental studies of pressure and thrust force evolution in the annular and linear dual slotted nozzles using the combustion products of acetylene–air mixture as a working gas.

Lopato and Utkin demonstrate the efficiency of their computational algorithm for the two-dimensional (2D) numerical simulation of propagating gaseous detonations using a completely unstructured computational mesh with triangular cells.

Tropin and Fedorov study computationally the interaction (transition, attenuation, and suppression) of the propagating gaseous detonations in silane–hydrogen–air mixtures of different composition with the clouds of SiO_2 micro- and nanoparticles.

Voronin studies computationally the initial stage of flow development and detonation initiation in the rotating detonation engine (RDE) of original design with separate delivery of fuel and oxidizer.

Fedorov and Lavruk investigate numerically the propagation of heterogeneous detonation of aluminum particles in gaseous oxygen in a plane channel with narrow and wide parts connected by a section of linear expansion.

Fedorov et al. simulate numerically the cellular structure of detonation waves propagating in oxygen suspensions of micro- and nanosized aluminum particles with bimodal size distribution.

Watanabe et al. study numerically the effect of water droplets and their evaporation on the gaseous detonation in the stoichiometric H_2–O_2 mixture diluted with nitrogen.

Sidorenko and Utkin solve numerically the problem of spherical particle movement behind the propagating shock wave applying the Eulerian method of treating moving boundaries based on the exact solution of the Riemann problem.

Khmel and Fedorov investigate numerically the formation of cellular detonation structures in monodisperse micron-, submicron-, and nanosized aluminum particle suspensions in oxygen.

Shiyi Liu et al. study experimentally the stability of carboxymethylcellulose used in space probes as an initiator in explosive actuators at extreme high and low temperatures for a long period of time.

Gorinov and Maslov provide the possible explanation to the abrupt transitions of high-speed to low-speed detonation modes or even detonation decay in the long charges of emulsion explosives based on their structure, density, and chemical composition.

Tukhvatullina and Frolov propose a well-posed mathematical model of nonisothemal two-phase two-velocity flow of bubbly medium with chemically inert liquid and chemically inert or active gas bubbles and validate the model against the experiments for propagating shock and detonation waves in bubbly liquids.

Chapter 3: Applications of Fast Combustion Modes and Detonations in Industry

Hayashi et al. present the results of 2D numerical simulations of RDE operation using the two-phase Euler equations with the two-step JP10/air reaction mechanism.

Kasahara et al. investigate experimentally the thrust performance of an RDE at low ambient pressure conditions simulating space environment, consider the design of the RDE-PDE (pulsed detonation engine) type second stage of the JAXA sounding rocket S-520, and perform long-duration on-ground combustion tests.

Molkov et al. simulate numerically the blast wave and fireball dynamics after high-pressure hydrogen tank rupture applying various submodels and numerical methods to reproduce available experimental data.

Jourdain et al. study experimentally the transmission of the detonation wave propagating in the stoichiometric propane–oxygen mixture from a straight channel to a curved chamber with a small inner wall in the form of cylinder or sharp edge.

Fotia et al. report three laboratory scale experiments providing a greater understanding of the physical and chemical processes in detonation-driven combustion devices.

Alhussan et al. investigate experimentally the thrust characteristics of a ramjet-type PDE operating on Jet A-1 – air mixture enriched with oxygen.

Bykovskii et al. study experimentally the modes of continuous spin detonation and continuous multifront detonation in a hydrogen–oxygen mixture in a plane-radial combustor with exhaustion toward the periphery.

Frolov, Aksenov, et al. demonstrate the autonomous flight of the unmanned aerial vehicle powered by the PDE ramjet operating on the standard aviation kerosene.

Frolov, Smetanyuk, et al. explore the possibility of utilizing the kinetic energy of detonation products by a pulse turbine of the simplest water-wheel-like design both computationally and experimentally.

Braun and Paniagua propose the RDE model for a turbojet engine and estimate the turbine efficiency using unsteady Reynolds-averaged Navier–Stokes simulations.

Frolov, Avdeev, et al. design, manufacture, and test a valveless pulsed detonation hydroramjet producing the thrust force due to shock-induced pulsed water jets periodically emanating from the water guide nozzle.

Frolov, Shamshin, et al. demonstrate the possibility of organizing a continuous-detonation combustion of a liquid fuel film in an annular combustor of a detonation liquid-propellant rocket engine.

I outlined the contents of the articles included in the book to enable easy selection of the subject of choice by the reader. A quick glance at the book contents indicates that there has been a considerable progress in the detonation research during recent years.

Editor