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Preface

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This Special Issue contains ten articles based on presentations given at the 2nd ECCOMAS (European Community on Computational Methods in Applied Sciences) Thematic Conference on Computational Combustion, held from July 18 to 20, 2007, at Delft University of Technology, The Netherlands. This thematic conference, focusing on all aspects of computational combustion, followed a conference on the same topic organized by and held at Instituto Superior Técnico, Technical University of Lisbon, in 2005.

The Conference was organized by Dirk Roekaerts (Chair), Bendiks-Jan Boersma and Kilian Claramunt, from the Delft University of Technology, and Pedro Coelho, from the Technical University of Lisbon. The objectives were to present the up-to-date state-of-the-art and current trends in numerical combustion, to address both fundamental and technological combustion issues. Six invited keynote lectures given by well known experts, Sébastien Candel, Johannes Janicka, Peter Lindstedt, Stephen Pope, Julien Réveillon and D. Scott Stewart, and, 39 contributed papers were presented at the Conference, which encompassed a wide range of subjects. Namely non-premixed and premixed flames were discussed along with direct and large-eddy simulations, transported pdf methods, chemistry tabulation, statistical

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models, droplets and sprays, soot, NO_x, radiation, combustion in porous media, mild and high temperature air combustion, HCCI engines, boilers and furnaces, and fires.

A paper by Pope and Ren opens this special issue with a review of efficient methods for detailed chemistry introduction in calculations and addresses skeletal mechanisms, dimension reduction, storage and retrieval algorithms, and adaptive chemistry. Then, turbulent combustion modeling of turbulent non-premixed or premixed gaseous flames is discussed in the next five papers. De Paola et al. focus on the application of conditional moment closure (CMC) to auto-ignition of n-heptane in a turbulent coflow of heated air. While simulations using a first-order closure for the conditional chemical source term were formerly published, the present contribution employs a second-order closure and compares three different implementations. The next paper by Cleary and Klimenko provides new insight into the multiple mapping closure (MMC) approach, which combines the CMC equations with a generalized mapping closure, and reviews different implementations of MMC models. Calculations of the well-known Sandia flame D are presented to support the physical reasoning behind the new interpretation of MMC. In the following contribution, Gkagkas et al. use the transported probability density function (PDF) for the joint scalars to model a bluff body stabilized turbulent diffusion flame with a high degree of local extinction. Then, two papers on large eddy simulation (LES) of premixed flames are included. Vreman et al. employ the premixed flamelet model along with four different models for the chemical source term to simulate a premixed preheated Bunsen flame. Predictions for Sandia flame D are also reported. Zhang et al. have solved the filtered transport equation for the progress variable with a turbulent flame speed closure. The model is applied to a typical industrial swirled stabilized combustor.

In the subsequent paper, Charwath et al. have investigated the properties of oscillating sooting methane air diffusion flames. A simple numerical approach is proposed to explain qualitatively the strong variations of the soot volume fraction in the oscillating flame found in experiments. The next two contributions focus on liquid fuels. Beck et al. analyzed the influence of gas phase turbulence on the NO_x formation and on the burning rate of a single droplet in a hot gas environment. Dionysios et al. studied the interacting physical and chemical phenomena that characterize the flow in a Stabilized Cool Flame Diesel fuel spray evaporation system. Two different modeling approaches have been evaluated. The paper by Felsch et al. closes this issue, with a contribution to the numerical simulation of a homogeneous charge compression ignition (HCCI) engine using an interactive approach that combines CFD with a zero-dimensional multi-zone code for chemical kinetics.

Together, the ten papers give an interesting perspective on the challenges of numerical combustion and the approaches to address them, as presented at the ECCOMAS 2007 conference held in Delft.