PREFACE

This special issue of the *International Journal for Numerical Methods in Fluids* contains expanded and updated versions of selected papers drawn from the Eighth International Conference on Numerical Methods for Thermal Problems held in Swansea in July 1993. The papers by invited specialists cover important aspects in the field of numerical solution of thermal problems. Numerical issues, heat transfer in turbulent flow, mould filling and casting, chemical reactions coupled with heat and mass transport, heat conduction and phase change are dealt with.

Numerical issues are addressed in the first two papers. Leonard and Drummond criticize the out of context use of conventional methods in numerical convective heat transfer analysis. An alternative to these methods is given by higher order methods, where with deferred correction solution methods and simple flux limiter methods physically correct solutions with optimal computational efficiency can be obtained. Comini, Manzan and Nonino present an error analysis for Bubnov–Galerkin and Taylor–Galerkin finite element schemes for convection type problems and determine stability limits. Operational equivalence between Taylor–Galerkin methods for pseudo-transient calculations and Petrov–Galerkin methods for steady state forms of advection–diffusion equations is also shown.

The next two papers deal with heat transfer in turbulent flow. Visser and Cilliers use for this problem and the connected prediction of the temperature distribution in the flow a revised turbulent conductivity model based on the k–e turbulence model. Numerical solutions are obtained by means of the finite difference method. Delenne, Manzoni and Pot propose a finite element method for solving unsteady Navier–Stokes equations for turbulent incompressible flow coupled with thermal problems. The method is applied to the analysis of the thermal boundary layer used to simulate walls with fixed temperature in turbulent flow.

The prediction of realistic thermal fields in mould filling and casting problems is addressed by Lewis, Usmani and Cross. A laminar regime for the flow field is obtained from the solution of the incompressible Navier–Stokes equation and the free metal surface from a pure advective equation. The thermal field is calculated by solving the convective-diffusive energy equation. Semi-implicit and explicit finite element methods are used and practical examples are shown.

Durbetaki, Phuoc, Mathur and Ekmann investigate radiative ignition of pyrolising solid fuels by simultaneously accounting for the following mechanisms: surface heat and mass transport, surface oxidation and gas phase chemical reaction, in depth pyrolisis and finally gas phase heating by absorption and conduction/convection. The solution of a 1D model is obtained numerically by the method of lines.

Tamma, Mei, Chen and Sha deal with recent advances in the effective virtual-pulse time integration method for multidimensional non-linear transient thermal analysis of structures and materials. The heat conduction equation is discretized in space by means of the finite element method. Maizza and Calì describe an induction heating model which couples the standard heat conduction equation with electromagnetic proximity-skin equations. An inverse finite element procedure is designed which is based on deterministic and probabilistic concepts.

Natural convection melting of a phase change material in an isothermal vertical cylinder is studied by Wu and Lacroix. The governing conservation equations are formulated in terms of stream function, vorticity and temperature. The numerical solution is obtained by finite differences. Finally Baggio, Majorana and Schrefler present a model for heat and mass transfer in deforming porous media, involving heat conduction and convection, vapour diffusion, liquid water flow and latent heat transfer due to phase change inside the pores. A two step finite element model is developed and applied to the thermo-hygrometric and mechanical analysis of concrete.

The broad range of subjects covered should make this issue a state of the art overview in the still actual and challenging field of computational methods in thermal problems.

Bernhard A. Schrefler