Preface

The present publication is the first chapter of the book in development entitled "Heat, Mass and Momentum Transport Network Models." The reason for publishing the first chapter before the completion of the entire book is to serve the practical need for technical reference for network models in ventilation, climate, and flow simulation in pipeline systems. The early publication will also help those interested in the theory of transport processes and in new methods of network solutions.

Coupled heat, mass, and momentum transport problems arise in many areas of science and engineering. With the increasing computational power coupled with new numerical solution techniques the ambition also grows for solving large-scale problems involving the flow and transport of scalar or vector substances. For this reason, network models are becoming widely used in industry, education and research, such as Ventsim, VnetPC, or VUMA, developed for modeling mines and interconnected tunneling systems. Such models are accessible to educators, students, scientists, or practicing engineers. Many of the new solution methods discussed in the book are available in a special edition of Ventsim, providing a user-friendly graphical interface for easy model configuration for the solution of large-scale, coupled network models.

The time-honored technique of network application is revisited in the book using flow network solutions for all transport process components for a coupled modeling task. The conservation laws for mass, energy, and momentum are formulated first specifically for the branches and nodes of transport networks using the combination of the Eulerian and Lagrangean modeling methods. With the extension of Bernoulli's original concept, a new solution is given for the flow field of viscous and compressible fluids as driven and governed by the balance of mechanical energy, coupled to the thermodynamics of the transport system. Applicable to simple or large-scale tasks, the new model elements and methods are built on first principles. Original formulations, their mathematical derivations, as well as applications in numerical solution schemes are provided throughout the work.

The numerical solution methods presented have been developed over two decades starting with ventilation and cooling enhancement studies supported by the

U.S. Department of Energy (DOE), Yucca Mountain Nuclear Waste Repository Office and continued for the development and qualification of the MULTIFLUX network code under grants from the Science and Technology Office of DOE. Their support is gratefully appreciated. I acknowledge with my thanks the long-term financial support from the National Institute of Safety and Health (NIOSH), U.S., for model developments and tests for the improvement in mine safety and health. The many research grants from other agencies and operating mines stretching over a decade from Nye County Natural Resources and Federal Facilities, Nevada; Barrick Goldstrike Mine and Newmont Gold Corporation, Nevada operations; as well as the Alpha Foundation are thankfully valued. The support from the Geothermal Project Office of DOE for opening a new application field for MULTIFLUX to model Engineered Geothermal Systems is gratefully recognized.

The critical comments from students in the Mine 725: Heat, Mass, and Momentum Transport Process graduate course over the last few years as well as from colleagues at the University of Nevada, Reno, Mackay School of Earth Sciences and Engineering are all acknowledged with my thanks.

Research Assistant Professor Davood Bahrami at the department deserves my warmest thanks for coding many of the network solution processes and setting up transport models for numerical tests and applications in various research projects. His participation in the software qualification of MULTIFLUX has been instrumental in the development and commercialization work. The partnership support from Director Craig Stewart together with other software developers at Chasm Consulting, Australia, for the integration of the MULTIFLUX model into the Ventsim Visual software is thankfully recognized.

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