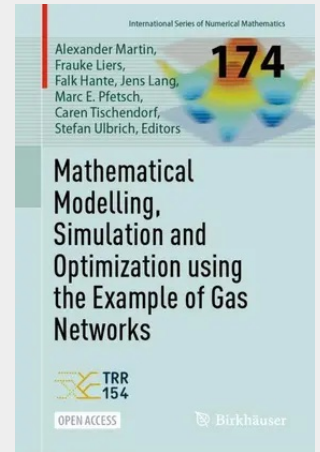


Mathematical Modelling, Simulation and Optimization using the Example of Gas Networks

This open-access book provides an overview of the state-of-the-art of mathematical approaches for networks with physical transport, in particular gas networks. This is motivated by the transformation of energy systems towards carbon neutrality and leads to fundamental mathematical challenges. Natural and hydrogen gas networks play a central role in this context, since they require a mathematical understanding of specific network structures with hierarchical hybrid models involving algebraic, ordinary, and partial differential-algebraic equations of hyperbolic type. Moreover, considering such networks in a market environment, ensuring feasibility of all market contracts under uncertain data and technical constraints requires certified methods that still pose challenges for current research and practice. Central to this effort is the integration of integer and nonlinear optimization under uncertainty as well as the design of new paradigms to handle the discrete–continuous interplay inherent in gas transportation. The book gives an overview of some of the research results that have been obtained within the German Collaborative Research Center CRC / TRR 154 funded by the German Science Foundation from 2014–2026. These methodological advances not only provide enabling technologies for the operation of gas networks and gas markets energy network certification but also contribute new mathematics with applications to other networked infrastructures such as power grids and water systems. The target audience is formed by researchers in the field of applied mathematics who want to know more about modelling, simulation, and optimization for solving challenging network-based systems, as well as domain experts in gas networks who want to get insights into the underlying mathematical questions. This book addresses United Nation's Sustainable Development Goals 7 (Affordable and Clean Energy), 9 (Industry, Innovation and Infrastructure) and 13 (Climate Action).

This open-access book provides an overview of the state-of-the-art of mathematical approaches for networks with physical transport, in particular gas networks. This is motivated by the transformation of energy systems towards carbon neutrality and leads to fundamental mathematical challenges. Natural and hydrogen gas networks play a central role in this context, since they require a mathematical understanding of specific network structures with hierarchical hybrid models involving algebraic, ordinary, and partial differential-algebraic equations of hyperbolic type. Moreover, considering such networks in a market environment, ensuring feasibility of all market contracts under uncertain data and technical constraints requires certified methods that still pose challenges for current research and practice. Central to this effort is the integration of integer and nonlinear optimization under uncertainty as well as the design of new paradigms to handle the discrete–continuous interplay inherent in gas transportation. The book gives an overview of some of the research results that have been obtained within the German Collaborative Research Center CRC / TRR 154 funded by the German Science Foundation from 2014–2026. These methodological advances not only provide enabling technologies for the operation of gas networks and gas markets energy network certification but also contribute new mathematics with applications to other networked infrastructures such as power grids and water systems. The target audience is formed by researchers in the field of applied mathematics who want to know more about modelling, simulation, and optimization for solving challenging network-based systems, as well as domain experts in gas networks who want to get insights into the underlying mathematical questions. This book addresses United Nation's Sustainable Development Goals 7 (Affordable and Clean Energy), 9 (Industry, Innovation and Infrastructure) and 13 (Climate Action).



53,49 €

49,99 € (zzgl. MwSt.)

vorbestellbar, Erscheinungstermin ca. Februar 2027

Artikelnummer: 9783032349682

Medium: Buch

ISBN: 978-3-032-34968-2

Verlag: Birkhäuser

Erscheinungstermin: 18.02.2027

Sprache(n): Englisch

Auflage: Erscheinungsjahr 2027

Serie: International Series of Numerical Mathematics

Produktform: Gebunden

Seiten: 519

Format (B x H): 155 x 235 mm

