

**EM**  
**S** ■  
**PRESS**

## EMS Textbooks in Mathematics

The *EMS Textbooks in Mathematics* is a series of books aimed at students or professional mathematicians seeking an introduction into a particular field. The individual volumes are intended not only to provide relevant techniques, results, and applications, but also to afford insight into the motivations and ideas behind the theory. Suitably designed exercises help to master the subject and prepare the reader for the study of more advanced and specialized literature.

Previously published in this series:

Peter Kunkel and Volker Mehrmann, *Differential-Algebraic Equations* (1st ed.)

Markus Stroppel, *Locally Compact Groups*

Dorothee D. Haroske and Hans Triebel, *Distributions, Sobolev Spaces, Elliptic Equations*

Thomas Timmermann, *An Invitation to Quantum Groups and Duality*

Oleg Bogopolski, *Introduction to Group Theory*

Marek Jarnicki and Peter Pflug, *First Steps in Several Complex Variables: Reinhardt Domains*

Tammo tom Dieck, *Algebraic Topology*

Mauro C. Beltrametti et al., *Lectures on Curves, Surfaces and Projective Varieties*

Wolfgang Woess, *Denumerable Markov Chains*

Eduard Zehnder, *Lectures on Dynamical Systems*

Andrzej Skowroński and Kunio Yamagata, *Frobenius Algebras I*

Joaquim Bruna and Juliá Cufí, *Complex Analysis*

Eduardo Casas-Alvero, *Analytic Projective Geometry*

Fabrice Baudoin, *Diffusion Processes and Stochastic Calculus*

Olivier Lablée, *Spectral Theory in Riemannian Geometry*

Dietmar A. Salamon, *Measure and Integration*

Andrzej Skowroński and Kunio Yamagata, *Frobenius Algebras II*

Jørn Justesen and Tom Høholdt, *A Course In Error-Correcting Codes* (2nd ed.)

Bogdan Nica, *A Brief Introduction to Spectral Graph Theory*

Timothée Marquis, *An Introduction to Kac–Moody Groups over Fields*

Piermarco Cannarsa and Filippo Gazzola, *Dynamic Optimization for Beginners*

Alain Bretto, Alain Faisant, and François Hennecart, *Elements of Graph Theory*

Alessio Figalli and Federico Glaudo, *An Invitation to Optimal Transport, Wasserstein Distances, and Gradient Flows* (2nd ed.)

Piotr W. Nowak and Guoliang Yu, *Large Scale Geometry* (2nd ed.)

Gareth Wilkes, *Profinite Groups and Residual Finiteness*



Peter Kunkel  
Volker Mehrmann

# Differential-Algebraic Equations

Analysis and Numerical Solution  
Second Edition



## Authors

Peter Kunkel  
Mathematisches Institut  
Universität Leipzig  
Leipzig, Germany  
Email: kunkel@math.uni-leipzig.de

Volker Mehrmann  
Institut für Mathematik  
Technische Universität Berlin  
Berlin, Germany  
Email: mehrmann@math.tu-berlin.de

**2020 Mathematics Subject Classification:** 34-01, 65-01 (primary), 34A09, 34A30, 34A36, 34D20, 34D30, 34B05, 34B15, 65L80, 65L10, 65L20, 65L06, 65L07 (secondary)

**Keywords:** linear differential-algebraic equation, non-linear differential-algebraic equation, differentiation index, strangeness index, regular differential-algebraic equation, index reduction, initial value problem, boundary value problem, generalized solution, control problem, optimal control, stability analysis, one-step method, multistep method, collocation method, stabilization

ISBN 978-3-98547-016-7, eISBN 978-3-98547-516-2, DOI 10.4171/ETB/28

### Bibliographic information published by the Deutsche Nationalbibliothek

The Deutsche Nationalbibliothek lists this publication in the Deutsche Nationalbibliografie; detailed bibliographic data are available on the Internet at <http://dnb.dnb.de>.

Published by EMS Press, an imprint of the

European Mathematical Society – EMS – Publishing House GmbH  
Institut für Mathematik  
Technische Universität Berlin  
Straße des 17. Juni 136  
10623 Berlin, Germany

<https://ems.press>

© 2024 EMS Press

Typesetting: Ashry Abdalla, Roisin, Belgium  
Printed in Germany  
♻️ Printed on acid free paper