A GUIDED TOUR OF MATHEMATICAL METHODS FOR THE PHYSICAL SCIENCES
THIRD EDITION

Mathematical methods are essential tools for all physical scientists. This book provides a comprehensive tour of the mathematical knowledge and techniques that are needed by students across the physical sciences. In contrast to more traditional textbooks, all the material is presented in the form of exercises. Within these exercises, basic mathematical theory and its applications in the physical sciences are well integrated. In this way, the mathematical insights that readers acquire are driven by their physical-science insight. This third edition has been completely revised: new material has been added to most chapters, and two completely new chapters on probability and statistics and on inverse problems have been added. This guided tour of mathematical techniques is instructive, applied, and fun. This book is targeted for all students of the physical sciences. It can serve as a stand-alone text or as a source of exercises and examples to complement other textbooks.

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Roel Snieder and Kasper Van Wijk
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We dedicate this book to our loving and beloved families:
Idske, Hylke, Hidde, and Julia,
and
Mila, Sasha, and Niels.
We also dedicate this book to our "scientific families":
our teachers and mentors, in particular Guust Nolet and John Scales,
our colleagues, and our students.

A GUIDED TOUR OF MATHEMATICAL METHODS FOR THE PHYSICAL SCIENCES THIRD EDITION

ROEL SNIEDER
Colorado School of Mines

KASPER VAN WIJK
University of Auckland

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Cover image: The image shows a soap bubble on a rotating table. The internal reflection of light within the soap film causes variations in the thickness of the film to show up as different colors. This laboratory experiment is used to study vortices in rotating systems; the experiment can be seen as a small-scale version of a hurricane. This figure is taken with permission from the following publication: Meuel, T., Y.L. Xiong, P. Fischer, C.H. Bruneau, M. Bessafi, and H. Kellay, *Intensity of vortices: from soap bubbles to hurricanes*, Scientific Reports, 3, p3455, 2013.

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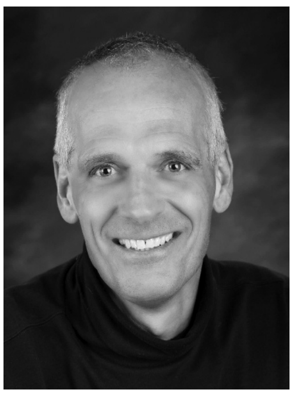

Roel Snieder.

Roel Snieder holds the Keck Foundation Endowed Chair of Basic Exploration Science at the Colorado School of Mines. In 1984 he received a master's degree in geophysical fluid dynamics from Princeton University, and in 1987 a PhD in seismology from Utrecht University. For this work he received the Vening Meinesz award from the Netherlands Organization for Scientific Research. In 1988 he worked as a postdoctoral Fellow in the "Equipe de Tomographie Géophysique" at the Université Paris VI and was appointed in 1989 as associate professor at Utrecht University. In 1993 he was promoted to full professor of seismology at Utrecht University, where from 1997 to 2000 he served as dean of the Faculty of Earth Sciences and spearheaded the integration of the research of the department with the Netherlands Institute of Applied Geoscience TNO. Roel served on the editorial boards of *Geophysical Journal International*, *Inverse Problems*, *Reviews of Geophysics*, and the *European Journal of Physics*. In 2000 he was elected as Fellow of the American Geophysical Union for important contributions to geophysical inverse theory, seismic tomography, and the theory of surface waves. He is author of the textbook *The Art of Being a Scientist*, published by Cambridge University Press. He teaches his class “The Art of Science” to universities and industry. From 2003 to 2011 he was a member of the Earth Science Council of the U.S. Department of Energy. In 2008 Roel worked for the Global Climate and Energy Project at Stanford University on outreach and education on global energy. In 2008 he was a founding member of the humanitarian organization “Geoscientists Without Borders.” Since 2010 he is director of the Center for Professional Education at the Colorado School of Mines. In 2011 he was elected as Honorary Member of the Society of Exploration Geophysicists. He received three teaching awards at the Colorado School of Mines. Roel was a volunteer firefighter from 2000 to 2014 and served as fire chief with Genesee Fire Rescue. For more information, visit his website `http://www.mines.edu/~rsnieder`.

Kasper van Wijk

Kasper van Wijk is a senior lecturer in the physics department at the University of Auckland in Auckland, New Zealand. Kasper is the director of the Physical Acoustics Laboratory at the University of Auckland (`http://physics.auckland.ac.nz/research/pal`). He studied geophysics in Utrecht (in the Netherlands) from 1991 to 1996, where he specialized in inverse theory. After teaching outdoor education in the mountains of Colorado, Kasper obtained his PhD in the Department of Geophysics at the Colorado School of Mines. After completing his PhD-degree, Kasper became a research faculty member at Colorado School of Mines. In 2006 Kasper van Wijk joined the geosciences department at Boise State University as an assistant professor. In 2011 he was awarded tenure and promoted to associate professor. In 2012, he moved to the Department of Physics at the University of Auckland, New Zealand, as a senior lecturer. His research interests center around elastic wave propagation in disordered media with applications ranging from medical imaging to global earth seismology. Kasper serves on the editorial board for the journal *Geophysics* and the *European Journal of Physics*.

He serves on the continuing education committee, as well as on the publications committee of the Society of Exploration Geophysicists. Kasper (co-)organized and taught geophysical field camps in Colorado, Oregon, and Thailand. His outreach efforts in Seismometers in Schools have exposed kids from 8–80 to the dynamic processes of our Earth.