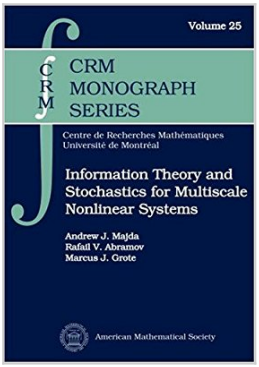

Information Theory and Stochastics for Multiscale Nonlinear Systems (Crm Monograph Series)

By Rafail V. Abramov, and Marcus J. Grote Andrew J. Majda

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This book introduces mathematicians to the fascinating mathematical interplay between ideas from stochastics and information theory and practical issues in studying complex multiscale nonlinear systems. It emphasizes the serendipity between modern applied mathematics and applications where rigorous analysis, the development of qualitative and/or asymptotic models, and numerical modeling all interact to explain complex phenomena. After a brief introduction to the emerging issues in multiscale modeling, the book has three main chapters. The first chapter is an introduction to information theory with novel applications to statistical mechanics, predictability, and Jupiter's Red Spot for geophysical flows. The second chapter discusses new mathematical issues regarding fluctuation-dissipation theorems for complex nonlinear systems including information flow, various approximations, and illustrates applications to various mathematical models. The third chapter discusses stochastic modeling of complex nonlinear systems. After a general discussion, a new elementary model, motivated by issues in climate dynamics, is utilized to develop a self-contained example of stochastic mode reduction. Based on A. Majda's Aisenstadt lectures at the University of Montreal, the book is appropriate for both pure and applied mathematics graduate students, postdocs and faculty, as well as interested researchers in other scientific disciplines. No background in geophysical flows is required. About the authors: Andrew Majda is a member of the National Academy of Sciences and has received numerous honors and awards, including the National Academy of Science Prize in Applied Mathematics, the John von Neumann Prize of the Society of Industrial and Applied Mathematics, the Gibbs Prize of the American Mathematical Society, and the Medal of the College de France. In the past several years at the Courant Institute, Majda and a multi-disciplinary faculty have created the Center for Atmosphere Ocean Science to promote cross-disciplinary research with modern applied mathematics in climate modeling and prediction. R.V. Abramov is a young researcher; he received his PhD in 2002. M. J. Grote received his Ph.D. under Joseph B. Keller at Stanford University in 1995.

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