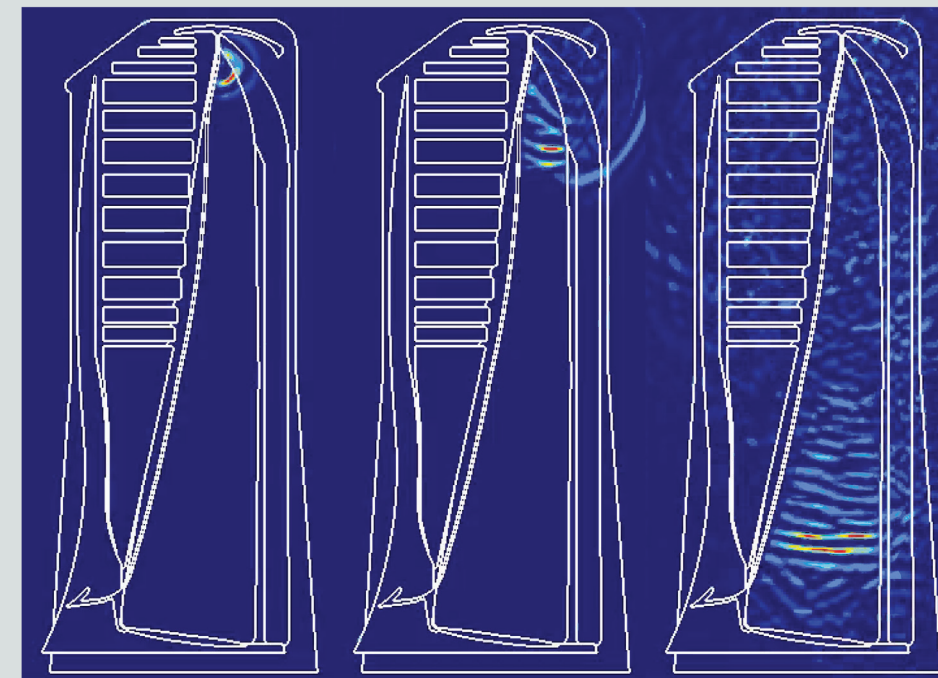


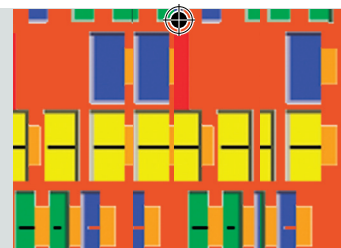


# A TOOLBOX FOR DIGITAL TWINS

## From Model-Based to Data-Driven



MARK ASCH



A TOOLBOX FOR DIGITAL TWINS  
From Model-Based to Data-Driven

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This book brings together the mathematical and numerical frameworks needed for developing digital twins. Starting from the basics—probability, statistics, numerical methods, optimization, and machine learning—and moving on to data assimilation, inverse problems, and Bayesian uncertainty quantification, the book provides a comprehensive toolbox for digital twins. Emphasis is also placed on the design process, denoted as the “inference cycle,” the aim of which is to propose a global methodology for complex problems.

Readers will find

- guidelines and decision trees to help them choose the right tools for the job;
- a comprehensive reference section with all recent methods, covering both model-based and data-driven approaches;
- a vast selection of examples and all accompanying code; and
- a companion website containing updates, case studies, and extended material.

*A Toolbox for Digital Twins: From Model-Based to Data-Driven* is for researchers and engineers, engineering students, and scientists in any domain where data and models need to be coupled to produce digital twins.



**Mark Asch** is a full professor of applied mathematics at University of Picardy Jules Verne. His research focuses on data assimilation, inverse problems, and their coupling with machine learning methods. His recent research includes acoustic monitoring of endangered whale species and optimal design of greener Li-ion batteries. For more than 30 years, he has taught applied statistics, machine learning, data assimilation, and numerical analysis, and he has consulted for industry and held positions at the Ministry of Research and

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