

Foundations of Signal Processing

By Martin Vetterli, Jelena Kova?evi?, Vivek K Goyal

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This comprehensive and engaging textbook introduces the basic principles and techniques of signal processing, from the fundamental ideas of signals and systems theory to real-world applications. Students are introduced to the powerful foundations of modern signal processing, including the basic geometry of Hilbert space, the mathematics of Fourier transforms, and essentials of sampling, interpolation, approximation and compression The authors discuss real-world issues and hurdles to using these tools, and ways of adapting them to overcome problems of finiteness and localization, the limitations of uncertainty, and computational costs. It includes over 160 homework problems and over 220 worked examples, specifically designed to test and expand students' understanding of the fundamentals of signal processing, and is accompanied by extensive online materials designed to aid learning, including Mathematica® resources and interactive demonstrations.

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Editorial Review

Review
"This is a major book about a serious subject - the combination of engineering and mathematics that goes into modern signal processing: discrete time, continuous time, sampling, filtering, and compression. The theory is beautiful and the applications are so important and widespread."
Gil Strang, Massachusetts Institute of Technology

"A refreshing new approach to teaching the fundamentals of signal processing. Starting from basic concepts in algebra and geometry, [the authors] bring the reader to deep understandings of modern signal processing. Truly a gem!"
Rico Malvar, Microsoft Research

"A wonderful book that connects together all the elements of modern signal processing ... it's all here and seamlessly integrated, along with a summary of history and developments in the field. A real tour-de-force, and a must-have on every signal processor's shelf!"
Robert D. Nowak, University of Wisconsin, Madison

"Finally a wonderful and accessible book for teaching modern signal processing to undergraduate students."
Stéphane Mallat, École Normale Supérieure

"Most introductory signal processing textbooks focus on classical transforms, and study how these can be used. Instead, Foundations of Signal Processing encourages readers to think of signals first. It develops a 'signal-centric' view, one that focuses on signals, their representation and approximation, through the introduction of signal spaces. Unlike most entry-level signal processing texts, this general view, which can be applied to many different signal classes, is introduced right at the beginning. From this, starting from basic concepts, and placing an emphasis on intuition, this book develops mathematical tools that give the readers gets a fresh perspective on classical results, while providing them with the tools to understand many state of the art signal representation techniques."
Antonio Ortega, University of Southern California

"Foundations of Signal Processing ... is a pleasure to read. Drawing on the authors' rich experience of research and teaching of signal processing and signal representations, it provides an intellectually cohesive and modern view of the subject from the geometric point of view of vector spaces. Emphasizing Hilbert spaces, where fine technicalities can be relegated to backstage, this textbook strikes an excellent balance between intuition and mathematical rigor, that will appeal to both undergraduate and graduate engineering students. The last two chapters, on sampling and interpolation, and on localization and uncertainty, take full advantage of the machinery developed in the previous chapters to present these two very important topics of modern signal processing, that previously were only found in specialized monographs. The explanations of advanced topics are exceptionally lucid, exposing the reader to the ideas and thought processes behind the results and their derivation. Students will learn ... why things work, at a deep level, which will equip them for independent further reading and research. I look forward to using this text in my own teaching."
Yoram Bresler, University of Illinois, Urbana-Champaign

About the Author
Martin Vetterli is a Professor of Computer and Communication Sciences at the École Polytechnique Fédérale

de Lausanne, and the President of the Swiss National Science Foundation. He has formerly held positions at Columbia University and the University of California, Berkeley, and has received the IEEE Signal Processing Society Technical Achievement Award (2001) and Society Award (2010). He is a Fellow of the ACM, EURASIP and the IEEE, and is a Thomson Reuters Highly Cited Researcher in Engineering.

Jelena Kova?evi? is the David Edward Schramm Professor and Head of Electrical and Computer Engineering, and a Professor of Biomedical Engineering, at Carnegie Mellon University. She has been awarded the Belgrade October Prize (1986), the E. I. Jury Award (1991) from Columbia University, and the 2010 Philip L. Dowd Fellowship at Carnegie Mellon University. She is a former Editor-in-Chief of IEEE Transactions on Image Processing, and a Fellow of the IEEE.

Vivek K Goyal is an Assistant Professor of Electrical and Computer Engineering at Boston University, and a former Esther and Harold E. Edgerton Associate Professor of Electrical Engineering at the Massachusetts Institute of Technology. He has been awarded the IEEE Signal Processing Society Magazine Award (2002), and the Eliahu Jury Award (1998) from the University of California, Berkeley, for outstanding achievement in systems, communications, control and signal processing. He is a Fellow of the IEEE.

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