Audio Signal Processing and Coding

By Andreas Spanias, Ted Painter, Venkatraman Atti

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An in-depth treatment of algorithms and standards for perceptual coding of high-fidelity audio, this self-contained reference surveys and addresses all aspects of the field. Coverage includes signal processing and perceptual (psychoacoustic) fundamentals, details on relevant research and signal models, details on standardization and applications, and details on performance measures and perceptual measurement systems. It includes a comprehensive bibliography with over 600 references, computer exercises, and MATLAB-based projects for use in EE multimedia, computer science, and DSP courses. An ftp site containing supplementary material such as wave files, MATLAB programs and workspaces for the students to solve some of the numerical problems and computer exercises in the book can be found at ftp://ftp.wiley.com/public/sci_tech_med/audio_signal

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Editorial Review

From the Back Cover
Master algorithms and standards for transparent coding of high-fidelity audio

Here is an in-depth treatment of algorithms and standards for transparent coding of high-fidelity audio. Readers learn how algorithms for high-quality digital audio deliver transparent signal reproduction with a minimum number of bits. The unique features of the book include detailed coverage of topics such as filter banks, transform coding, sinusoidal analysis, linear prediction, hybrid algorithms, perceptual evaluation methods, scalable algorithms, Internet applications, MP3 and MP4 stereo systems, and current international and commercial audio standards.

Following a general introduction, the authors present fundamental signal processing concepts relevant to audio coding and then introduce waveform and entropy quantization schemes. Next are thorough treatments of the following topics:

- Linear prediction, ADPCM, and CELP algorithms for narrowband and wideband coding
- Cellular telephony vocoders versus CD-quality audio coders
- Perceptual modules including the ISO/IEC 11172-3 (MPEG-1) psychoacoustic analysis model
- Detailed descriptions of the MPEG-1 Layer III (MP3) and the AAC (MP4) algorithms
- Descriptions of the algorithms behind successful products such as the Apple iPod
- Filter bank design and algorithms and the Modified Discrete Cosine Transform (MDCT)
- Established and emerging standards for transparent coding of CD-quality stereo audio signals
- Standardization activities in high-fidelity audio coding, including DVD-Audio, Super Audio CD (SACD), Dolby AC3, Digital, Digital Theater Systems (DTS), and Sony SDDS surround sound
- Lossless audio coding and digital audio watermarking techniques, including SHORTEN, DVD-algorithm, MUSICompress, AudioPaK, C-LPAC, LTAC, and IntMDCT lossless coding schemes
- Surround sound compression algorithms for cinema and super audio CD applications
- Digital audio watermarking, content protection, and copyright issues
- Complexity, delay, error control, and subjective quality in perceptual audio coding

Computer exercises and MATLAB® hands-on projects complement the algorithm theory and reinforce concept learning. A comprehensive bibliography with more than 600 references to additional sources of information to explore individual topics in greater depth.

This textbook includes all the right elements and topics for a senior and/or graduate-level course in speech/audio processing and multimedia. Moreover, it is highly recommended for practitioners, scientists, and audio engineers who want to master coding algorithms for high-fidelity audio.

About the Author
ANDREAS SPANIAS, PhD, is Professor in Electrical Engineering at Arizona State University (ASU). He has led the development of the award-winning online software Java-DSP. His research interests include adaptive filters, speech/audio processing, multimedia, and sensor arrays. He is an IEEE Fellow and co-recipient of the IEEE Donald Fink Prize Paper Award for his work on audio coding. He was recognized by Intel Corporation for his contributions to the 60172 architecture. He is currently Associate Director of the

ASU AME program and Co-Director of the ASU SenSIP Center.

TED PAINTER, PhD, obtained his doctorate at ASU in 2000. He is a multimedia software architect in the Mobility and Wireless Group at Intel Corporation. His work focuses on architectural analysis, high-performance multimedia software design for mobile handsets, and definition of industry standards. He is editor of the Khronos OpenMAX DL specification. His research interests include psychoacoustics and speech and audio processing. He is co-recipient of the IEEE Donald Fink Prize Paper Award for his work on perceptual coding of digital audio.

VENKATRAMAN ATTI, PhD, obtained his doctorate at ASU in 2006. He currently works as a senior engineer at Acoustic Technologies, Inc. While at ASU, he contributed to speech and audio coding, and to the Java-DSP package. His work in integrating perceptual criteria in linear predictive coding was nominated for an award at IEEE ICASSP-2005. At Acoustics Technologies, his work focuses on research and development of acoustic echo cancellation and noise reduction algorithms.

Users Review

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Jill Spann:

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