UNDERWATER ACOUSTIC DIGITAL SIGNAL PROCESSING AND COMMUNICATION SYSTEMS
Underwater Acoustic Digital Signal Processing and Communication Systems

Edited by

Robert S.H. Istepanian
Brunel University

and

Milica Stojanovic
MIT

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Underwater acoustic digital signal processing and communications is an area of applied research that has witnessed major advances over the past decade. Rapid developments in this area were made possible by the use of powerful digital signal processors (DSPs) whose speed, computational power and portability allowed efficient implementation of complex signal processing algorithms and experimental demonstration of their performance in a variety of underwater environments. The early results served as a motivation for the development of new and improved signal processing methods for underwater applications, which today range from classical sonar signal processing, to remote control of autonomous underwater vehicles and underwater wireless communications.

This book presents the diverse areas of underwater acoustic signal processing and communication systems through a collection of contributions from prominent researchers in these areas. Their results, both new and those published over the past few years, have been assembled to provide what we hope is a comprehensive overview of the recent developments in the field. The book is intended for a general audience of researchers, engineers and students working in the areas of underwater acoustic signal processing. It requires the reader to have a basic understanding of the digital signal processing concepts. Each topic is treated from a theoretical perspective, followed by practical implementation details. We hope that the book can serve both as a study text and an academic reference.

The topics of the book have been chosen to reflect the emergence of new applications of underwater acoustic signal processing. The book is organised in eight chapters. In Chapter 1, M. Stojanovic introduces the readers to the problem of underwater acoustic communications. Basic characteristics of underwater communication channels and existing communication systems are surveyed, and
processing methods required for detection of high-rate communication signals are
described. In Chapter 2, M.Zakharia and J.Chatillon address the implementation
problems associated with synthetic aperture mapping and imaging systems. The
performance of several imaging methodologies in sea trials is presented. A
description of a micro-controller based underwater biotelemetry system is presented
in Chapter 3 by R. Istepanian. The hardware and software of this underwater
monitoring system are described, and results of a SCUBA diver’s physiological
performance are presented. In Chapter 4, digital underwater voice communications
are addressed by H. Sari and B. Woodward. They present a DSP-based voice
communication system that includes a speech compression method suitable for
transmission over an underwater acoustic channel. In chapter 5, Z. Zhaoning
addresses application of neural networks to underwater acoustic signal processing. A
review of fundamentals of neural networks is given, followed by the description of
implementation architectures relevant for underwater acoustic applications. In
chapter 6, J.D. Penrose and T. Pauly describe the process of gaining information
about targets from ensembles of backscattered acoustic signals. Target strength
estimation is addressed from both a theoretical and an experimental viewpoint.
Chapter 7, by H. Junjying, L. Liu, F. Haihong and L. Hong, presents a modulation /
coding scheme based on delay estimation in the acoustic channel. The concept is
demonstrated through experimental results of shallow water testing. The final
chapter, by A. Trucco, M. Palmese, A. Fusiello and V. Murino, is devoted to 3-D
underwater acoustic imaging. An acoustic model of the scene to be imaged is
developed and a method for segmentation and reconstruction of images is presented
in the framework of real-time system requirements.

Finally, we would like to express our thanks and gratitude to all the authors for their
excellent contributions. We would also like to thank Mr. Finlay and Ms. Lufting at
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LIST OF CONTRIBUTORS

Jacques Chatillon  
INRS, Avenue de Bourgogne  
B27, 54501, VANDOEUVRE  
Cedex, France

Andrea Fusiello  
Department of Computer Science,  
University of Verona,  
Italy

Feng Haihong  
Underwater Acoustics Institute,  
Harbin Engineering University,  
Harbin 150001,  
P.R. China

Liu Hong  
Underwater Acoustics Institute,  
Harbin Engineering University,  
Harbin 150001,  
P.R. China

R.S. H. Istepanian  
Department of Electronic & Computer Engineering,  
Brunel University, Uxbridge, Middlesex, UB8 3PH,  
UK  
E-mail: Robert.Istepanian@brunel.ac.uk

Hui Junying  
Underwater Acoustics Institute,  
Harbin Engineering University,  
Harbin 150001,  
P.R. China

Liu Li  
Underwater Acoustics Institute,  
Harbin Engineering University,  
Harbin 150001,  
P.R. China

Vittorio Murino  
Department of Computer Science  
University of Verona,  
Italy
Maria Palms
Department of Biophysical and Electronic Engineering,
University of Genova,
Italy

T. Pauly
Australian Antarctic Division,
Channel Hwy., Kingston 7050, Tasmania,
Australia

J.D. Penrose
Centre for Marine Science and Technology,
Curtin University of Technology,
Kent St., Bentley 6102, Western Australia,
Australia

H. Sari
Department of Electronic and Electrical Engineering,
Loughborough University, LE11 3TU,
UK

M. Stojanovic
Massachusetts Institute of Technology
Cambridge, MA, 02139,
USA

Andrea Trucco
Department of Biophysical and Electronic Engineering,
University of Genova,
Italy

B. Woodward
Department of Electronic and Electrical Engineering,
Loughborough University, LE11 3TU,
UK

Manell E. Zhakaria
Ecole Navale/IRENAV
French Naval Academy/Underwater Acoustics Group
29360 Brest NAVAL,
France

Zheng Zhaoning
Department of Radio Engineering,
Southeast University, Nanjing,
210018,
P.R. China