

Preface

The first edition of *An Introduction to Underwater Acoustics* was published by Praxis in 2002, and proved to meet a fair success. Soon afterwards (2008), I was asked by Praxis to prepare a second and updated edition. This proved an excellent opportunity to correct the mistakes and imperfections that had come to light, and to complement the new book with a number of significant additions, brought about in particular by the dynamism of research and developments in underwater acoustics and its applications. One thing leading to another, the revision and complement of the first edition finally led to a significantly different result.

The purpose remains the same, namely to introduce to newcomers the main principles, theories, and practical applications of underwater acoustics, and provide others with a refresher or quick summary of fields they might not be familiar with. This book is not aimed at the specialists of the field – although they can possibly find here or there a point of interest. The goal is to present underwater acoustics from a pragmatic and practical point of view, under a form that is (at least partially) accessible to many – and not only to postgraduates in physics or signal processing, for which a rich theoretical literature already exists.

My intent was to make the second edition more exhaustive, by adding subjects not addressed before (bioacoustics, geophysical exploration), by going deeper into some topics, and of course by improving the existing material. The first chapters, dealing with the principles, remain basically the same in their overall structure with some additions that hopefully improve them. The part of the book presenting underwater acoustics applications is now divided into three chapters (water column, seafloor, and sub-bottom); and a new chapter on bioacoustics was added. The various appendices were very significantly increased, including a series of exercises and problems, with numerical solutions, based on my own teaching over the last decades.

The first-edition chapter about propagation was lacking a real insight into the parabolic equation method. This has since been provided by Luc Leviandier; beyond

this particular topic, Luc did improve my previous presentation of the classical methods of propagation modeling (rays and modes). The section about ambient noise was completed with some new material provided by Philippe Blondel and Melanie Collins (formerly Keogh), including some very recent research results.

In the first edition of this book, the sections about transducers had been written by my colleague Yves Le Gall. In this new version, Yves added some new material about important and overlooked issues such as impedance adaptation and transmitter design.

Although they are not still widely used in practical applications, high-resolution methods have been a major topic of research for the last decades. They were not presented at all in the first version; the presentation given here is due to Christophe Sintès and Gerard Llorç-Pujol, who also participated in the section about interferometry.

In the application chapters, major contributions were also provided by Gérard Lapierre, for the various aspects of underwater communication principles and applications; Christophe Vrignaud for the Doppler current profilers; Valérie Mazauric for fishery acoustics.

One of my intents was to develop much more than in the first edition the pages about sub-bottom acoustic investigation. So one full chapter is now dedicated to this issue. For this topic, the specialist's support was given by my colleague Anne Pacault, who corrected my first writing and indeed changed it into something more acceptable by bringing a lot of very relevant material. Presenting seismic exploration techniques in around fifty pages was a real challenge, and we hope that this approach will meet the expectations of many readers and encourage them to look at the more complete (and complex) textbooks dedicated to deeper exploration of specific topics.

Bioacoustics is a subject of growing importance inside underwater acoustics. The widespread and increasing concerns about acoustic pollution, above and under water, will lead to more and more specific regulations; this cannot go without a better understanding of the sound production and auditory mechanisms of marine animals. A dedicated chapter about these topics, with a strong emphasis on marine mammals, was written by Stacy DeRuiter, during her post-doctoral stay at Ifremer. Stacy's approach is of course more orientated at biology than engineering, but hopefully the result is in a good continuity with the rest of the book and will provide a useful source of information.

An effort was also made to improve the pictorial content of the book – photographs of hardware and examples of actual data. I would like to thank here for their support the companies Thales Underwater Systems, Kongsberg Maritime, Sercel, Klein, iXSea, DCNS, Total, Humminbird, Teledyne-RDI, Nortek, HTI; and the various colleagues, mainly from Ifremer and SHOM, who provided me with data and experimental results.

Besides the contributors listed above, many colleagues contributed at various stages to the completion achievement of this new version, by telling me about errors they had found, by bringing helpful and constructive suggestions, and finally by reading and checking the new material. Foremost amongst them, I would like to cite and thank Dick Simons, Andrea Trucco, Michael Ainslie, Bjørnar Langli, Yann

Stéphan; and above all Jacques Marchal, who spent his Parisian commuting hours for weeks checking the new manuscript in every detail.

It is my pleasure to thank very warmly all the co-authors and contributors listed above – and everyone who helped me in this new attempt.

To conclude, I would like to acknowledge the constant, faultless and friendly support from my editor Philippe Blondel, and from the entire Praxis team.

And it is – last but not least! – time to dedicate this book to my wife Françoise and our children Thibaut, Jean-Baptiste, Bérénice and Gauthier.

Xavier Lurton
Locmaria-Plouzané, January 2010



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Lurton, X.

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