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Digital Signals, Processors and Noise

Paul A. Lynn

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Macmillan New Electronics
Introductions to Advanced Topics

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Series Editor's Foreword

The rapid development of electronics and its engineering applications ensures that new topics are always competing for a place in university and polytechnic courses. But it is often difficult for lecturers to find suitable books for recommendation to students, particularly when a topic is covered by a short lecture module, or as an 'option'.

This Series offers introductions to advanced topics. The level is generally that of second and subsequent years of undergraduate courses in electronic and electrical engineering, computer science and physics. Some of the authors will paint with a broad brush; others will concentrate on a narrower topic, and cover it in greater detail. But in all cases the titles in the Series will provide a sound basis for further reading of the specialist literature, and an up-to-date appreciation of practical applications and likely trends.

The level, scope and approach of the Series should also appeal to practising engineers and scientists encountering an area of electronics for the first time, or needing a rapid and authoritative update.

Paul A. Lynn

Preface

In putting together this short text on Digital Signal Processing (DSP), I have had three main objectives. Firstly, I wanted to provide undergraduate students – as well as postgraduates and practising engineers needing an introduction to the field – with a concise and accessible account of the theoretical background to DSP and its practical applications. Secondly, since it is now commonplace for the individual to own (or have ready access to) a personal computer, I decided to illustrate key DSP topics and design methods with computer programs. And finally, knowing that most newcomers to DSP find the topic of digital noise, and signals in noise, especially difficult, I have included introductory chapters on the description and processing of random sequences.

Some of these objectives perhaps deserve a little more explanation. As far as the computer programs are concerned, I feel sure that there is a great deal to be gained, in both confidence and understanding, by using and modifying DSP programs on a general-purpose computer, and by seeing the results of digital processing build up on a computer screen. A large number of figures in the text have been produced in this way, and I hope that many of my readers will have the chance to reproduce the graphical outputs, and experiment with further programs of their own. Incidentally, quite a number of the figures have previously been used in my book *Introductory Digital Signal Processing with Computer Applications*, co-authored with Wolfgang Fuerst and published by Wiley in 1989, and I am grateful for the publisher's agreement to include them. The programs are listed in both BASIC and PASCAL in Appendix A, and although they cannot do more than indicate some of the possibilities of this approach to teaching and learning DSP, I hope they will be found useful.

As far as noise, and signals in noise, are concerned, many years of teaching these topics (in both analog and digital versions) convinced me that an approach with copious illustrations should be attractive to students and allow them to visualise the essential mathematical background. The mathematics itself I have kept as simple as possible, consistent with the need for accuracy; and I have tried, at every stage, to illustrate the main theoretical results by involving the reader in the actual business of

processing random digital signals and noise sequences on a digital computer.

Of course, any book of this length on a huge subject must be selective. I decided early on that it would be sensible to cover the basic theory of linear DSP and its application using general-purpose computers reasonably thoroughly, but omit any material on hardware or VLSI aspects. The result is inevitably a compromise, but one which I trust will appeal across a wide range of engineering and scientific disciplines, especially to those who need an accessible introduction without getting involved, so to speak, in the nuts and bolts of the subject.

Paul A. Lynn
Bristol, 1992