Preface

If we consider the appearance of Max Mathews' first direct digital synthesis program for the IBM 704 mainframe, MUSIC I, as marking the year zero of computer music, then the field is about to reach its sixtieth anniversary in 2018. Throughout these years, amazing developments in software and hardware technology made the production of (digital) electronic music a common feature of today's music. For the first few decades, access to computers for sound creation was limited to only a few lucky individuals. With the popularisation of microcomputers, a revolution was initiated, allowing a much a wider host of practitioners to avail themselves of these wonderful devices. This has continued today and I expect it will extend well into the future, as new possibilities emerge for music, sound art, sound design, and related activities. The personal computing tools we have at hand today, which have various forms, sizes, and capabilities, are incredibly powerful platforms for the development and manipulation of new sound-making objects. This book is dedicated to the study of these computer instruments from the ground up.

The text is organised into three parts, covering three aspects of the topic: foundations; instrument development from the perspective of signal processing; and the design of applications on existing computer music platforms. The first chapter, in Part I, explores basic concepts relating to audio signals in and out of the computer. It provides a gentle introduction to some key principles that will be used throughout the book, with a touch of mathematics and plenty of illustrative examples. This is followed by an introduction to the programming tools that will be used in the following two parts of the book, Python, Csound, and Faust. These three languages were judiciously chosen to cover a wide variety of applications, which range from demonstrating signal-processing algorithms to implementing full applications. Another important feature of these three environments is that they can be nicely interleaved, from a higher to a lower level, and from an application-development to a signal-processing function. This is demonstrated by a full example at the end of the chapter.

The second part of the book is fully devoted to exploring ways of making sound with a computer, the signal-processing design for instruments. It includes some classic approaches, such as source-filter models, clever ways of manipulating mathe-

matical formulae, newer approaches to feedback and adaptive techniques, and the methods of granular synthesis. Part II is complemented by a thorough examination of the principles of frequency-domain analysis-synthesis principles. Although these chapters tend to make continued use of mathematical expressions, the discussion also employs graphical plots and programming examples to complete the exploration of each technique. This three-pronged approach is aimed at providing a full perspective and a thorough examination of these sound-generation algorithms.

Finally, in the third part, we look at some complementary aspects of instrument design: interaction tools and development platforms. Chapter 8 explores various means of communication with sound synthesis programs, with examples presented in the three target programming environments. We also examine graphical user interfaces and the principles of custom hardware for sound control. The final chapter in the book then discusses the various platforms for the development and performance of computer instruments.

This book is designed for readers of different levels of expertise, from musicians to sound artists, researchers, software developers, and computer scientists. More experienced users may want to skip some of the introductory points in Part I, depending on their background. Readers who are unsure about the mathematical language used can avail themselves of Appendix A where all concepts applied in the book are thoroughly explained (assuming just a basic understanding of arithmetics). All important code that is not completely provided in the main text of the book appears fully in Appendix B and is referenced in the relevant chapters.

I hope that this book will prove to be a useful reference for computer music practitioners on the topic of instrument development. It aims to provide a solid foundation for further research, development, music-making, and sound design. Readers are encouraged to experiment with the examples and programs presented here as they develop new perspectives in their practice of sound and music computing.

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