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Elaine Chew

Mathematical and Computational Modeling of Tonality

Theory and Applications

Springer

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This book is dedicated to

my father, Chew Kim Lin, who instilled in me a love for mathematics,

George Dantzig, in memoriam, who gave me my first glimpse into research, and

Jeanne Bamberger, who showed me I could combine it all with music

Preface

Blending ideas from operations research, music psychology, music theory, and cognitive science, this book aims to tell a coherent story of how tonality pervades our experience, and hence our models, of music.

The story is told through the developmental stages of the Spiral Array model for tonality, a geometric model designed to incorporate and represent principles of tonal cognition, thereby lending itself to practical applications of tonal recognition, segmentation, and visualization. Mathematically speaking, the coils that make up the Spiral Array model are in effect helices, a spiral referring to a curve emanating from a central point. The use of "spiral" here is inspired by spiral staircases, intertwined spiral staircases: nested double helices within an outer spiral.

The book serves as a compilation of knowledge about the Spiral Array model and its applications, and is written for a broad audience ranging from the layperson interested in music, mathematics, and computing to the music scientist–engineer interested in computational approaches to music representation and analysis, from the music–mathematical and computational sciences student interested in learning about tonality from a formal modeling standpoint to the computer musician interested in applying these technologies in interactive composition and performance. Some chapters assume no musical or technical knowledge, and some are more musically or computationally involved.

I am extremely pleased that this book is to appear fifteen years after the eureka moment that gave rise to the Spiral Array model, and five years—and five house moves, including one cross-country and one cross-Atlantic—after the book proposal, formulated and accepted while I held the Edward, Frances, and Shirley B. Daniels Fellowship at the Radcliffe Institute for Advanced Study. The collaborators who have contributed to this volume include Alexandre R. J. François, Ching-Hua Chuan, and Yun-Ching Chen; our joint work forms the basis of the chapters on visualization, audio key finding, and pitch spelling. Alex is additionally author of the MuSA_RT Mac App, an interactive visualization software based on the Spiral Array that is a part of the supplemental material for this book.

This compendium would not have been possible without the support of Jeanne Bamberger, who has been a mentor well beyond my doctoral research, Kim Lin Chew, my father and the only person I know willing to proofread equations, and other long-suffering members of my family. I thank Jordan Smith for his last-minute voluntary proofreading, Doug Keislar for his (in)voluntary edits to the

book draft, the late Lindy Hess for her generous advice on the book proposal, Matthew Amboy for speedy feedback on the book drafts, Camille Price, incoming series editor, for her steadfast encouragement over the years, and Fred Hillier, a former teacher, whose optimism and impending departure as Series Editor provided the catalyst to finally complete the book.

Last but not least, I thank the anonymous student who asked the seemingly innocuous question, "What do you mean by key?," that started this whole undertaking.

London, Singapore, Los Angeles, Boston, August 2013 Elaine Chew

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