

# Preface

Looking back, as we put the finishing touches to this book, it is hard to believe just how fortunate we have been to complete a project of this type. We were incredibly lucky to have been present at the birth of an idea and to have seen that idea blossom into a rich framework that can be used to answer important questions about the additive increase multiplicative decrease (AIMD) algorithm and to offer the promise of answering still unresolved questions about AIMD. Representing a decade of research on the part of the authors and our colleagues, this book documents some of the key results that arise from this one idea. The idea in question is a simple one: to associate a certain type of stochastic matrix with a particular resource allocation problem and to see where this formulation leads. The resulting journey was exciting and revealing, leading to explorations in probability theory, switched positive systems, Markov chains, iterated function systems, and some very strange nonlinear dynamical systems. It is indeed a remarkable fact that the AIMD algorithm seems to lie at the intersection of all these disciplines.

This book is also about people. Many researchers in addition to the authors have contributed to its contents. Perhaps the principal contributor in this regard is Douglas Leith: also present for the birth of “our idea,” he not only made very significant contributions to the theory of AIMD matrices reported in this book but also, more than anyone else, championed its use and acceptance in the networking community. Special recognition is also due to Avi Berman, Arieh Leizarowitz, and Uri Rothblum. Sadly, the latter two authors are no longer with us, but their work forms a pivotal part of this book. Thanks are also due to the students, postdocs, visitors, and former colleagues who have helped make our journey possible: Rade Stanojević, Arieh Schlote, Robert Kilduff, Baruch Evan, Alan Rogers, Gavin McCullagh, Sonja Stüdli, Chris Kellett, Mehmet Akar, Emanuele Crisostomi, Rick Middleton, Peter Wellstead, and Ken Duffy. Finally, we are greatly indebted to Emanuele Crisostomi, Christoph Kawan, and Björn S. Ruffer, who read large parts of earlier versions of this book and have supplied us with numerous useful suggestions for improvement. Further thanks goes to Philipp Danner, who has created nice versions of many of the figures in this book. All remaining errors in fact or judgment remain with the authors. Finally, Robert Shorten, Martin Corless, and Fabian Wirth gratefully acknowledge the support of the EU FP7 project INSIGHT (grant number 318225) and the Science Foundation Ireland (grant number 11/PI/1177) in developing the material in Chapter 15.

Most of all, this book is about a very special place. All of our results were spawned at the Hamilton Institute at the National University of Ireland (NUI), Maynooth in the period 2004–2014. Founded in 2001 as a center for control theory, it became much more than this. The Hamilton is a remarkable place, and over time, became associated with linear algebra, probability, networking, mathematical biology, and switched systems research of the highest standard. Characterized by collegiality and openness and as a forum for frank and open exchange, the Hamilton is most of all a welcoming place for researchers and their ideas. It was an amazing place to work and gave birth not only to a community

of researchers but also to a worldwide network of friends. Mark Twain once said that in Berlin, one can learn anything, except German. Had he experienced the Hamilton, he might have said that at Hamilton, one can learn anything, even control theory. The subject of this book exemplifies this statement. Starting out as an exploration in control theory and linear algebra, the pursuit of the AIMD idea involved long and winding journeys through varied subject areas and encompassed an ensemble of research collaborations that spanned the globe. The breadth of ideas and collaborations that engendered this book is a fitting tribute to the Hamilton Institute, the place, the concept, and its scientific ethos.

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