# Foreword

The Audio Programming Book and DVD, created by Boulanger and his associates, is not just a book; **it is an encyclopedia (!)**, the encyclopedia of mathematical and programming techniques for audio signal processing. It is an encyclopedia focused on the future, but built upon the massive foundations of past mathematical, signal processing, and programming sciences.

It is clearly written and easy to understand, by both human readers and by computers. It gives complete information from the basic mathematics to the detailed programs needed to make sound. It is the essential library, not only for computer musicians, but also for all computer scientists including those who work in the fields of communication and artificial intelligence.

Today the dominant language in which to write programs is C (including C++). A half-century ago, sound synthesis programs for music were written in assembly language. The resulting music had few voices and uninteresting timbres. Programs were tedious to write. Block diagram compilers, including *Music V*, *cmusic* and *Csound*, greatly expanded the musical possibilities by giving composers and sound designers tools to create their own timbres from blocks of code – from oscillators, envelopes, filters, mixers, etc. These blocks performed tasks that electronic musicians were familiar with and that they could understand. Block diagram compilers were a great step forward, but

they imposed limits on what the computer was allowed to do, essentially because of their limited library of audio modules or opcodes.

These limits have now been swept away. The Audio Programming Book makes it practical to write a new C program for each new piece of music. The composition IS the C program. This is the great step forward, realized by The Audio Programming Book!

A half-century ago computer sound processing was limited by the speed and expense of existing hardware. Today those limits are gone. Laptop computers, that anyone can afford, are ten to one hundred thousand times more powerful than the room full of equipment in a typical 1960's computer center. And now, this book sweeps away the programming limits and makes practical musical use of the great power of laptops.

Early computers could not do real-time performance – they took many seconds to compute a single second of sound. But today, real-time performance is possible; and practical real-time programming is a big part of this book. Thus, laptops can join with chamber groups and orchestras and thereby add rich new timbres to the already beautiful timbers of acoustic instruments.

What now is the musical challenge of the future? I believe it is the limits in our understanding of the human brain; and specifically knowing what sound waves, sound patterns, timbres and sequences that humans recognize as beautiful and meaningful music – and why! The Audio Programming Book is a great tool to copiously produce the sounds and music we need to truly and deeply explore these many and hidden dimensions of our musical minds.

Max V. Mathews