

# Contents

1	Getting started with SuperCollider	1
1.1	About SuperCollider	1
1.2	SC overview	3
1.3	Installation and use	6
1.4	Objectives, references, typographical conventions	9
2	Programming in SC	13
2.1	Programming languages	13
2.2	Minima objectalia	16
2.3	Objects in SC	19
2.4	Methods and messages	26
2.5	The methods of type post and dump	33
2.6	Numbers	36
2.7	Conclusions	39
3	Syntax: basic elements	41
3.1	Brackets	41
3.2	Expressions	42
3.3	Comments	43
3.4	Strings	44
3.5	Variables	45
3.6	Symbols	49
3.7	Errors	51
3.8	Functions	52
3.9	Classes, messages/methods and keywords	57
3.10	A graphic example	59
3.11	Control Structures	64
3.12	Yet another GUI example	67
3.13	Conclusions	71

4	Synthesis, I: Fundamentals of Signal Processing	73
4.1	A few hundred words on acoustics	73
4.2	Analog vs. digital	76
4.3	Synthesis algorithms	81
4.4	Methods of Signal	89
4.5	Other signals and other algorithms	93
4.6	Still on signal processing	105
4.7	Control signals	109
4.8	Conclusions	117
5	SC architecture and the server	119
5.1	Client vs. Server	119
5.2	Ontology of the server as an audio synthesis plant	123
5.3	The server	132
5.4	SynthDefs	134
5.5	UGens and UGen graphs	138
5.6	Synths and Groups	144
5.7	A theremin	149
5.8	An example of real-time synthesis and control	151
5.9	Expressiveness of the language: algorithms	154
5.10	Expressiveness of the language: abbreviations	156
5.11	Conclusions	160
6	Control	161
6.1	Envelopes	161
6.2	Generalizing envelopes	167
6.3	Sinusoids & sinusoids	174
6.4	Pseudo-random signals	180
6.5	Busses	184
6.6	Procedural structure of SynthDef	197
6.7	Multichannel Expansion	201
6.8	Conclusions	208

# Introduction to SuperCollider

7	Organized sound: scheduling	211
7.1	Server-side, 1: through UGens	211
7.2	Server side, 2: Demand UGen	217
7.3	Language-side: Clocks and routines	221
7.4	Clocks	226
7.5	Synthesizers vs. events	229
7.6	Graphic interlude: drawings and animations	236
7.7	Routines vs. Tasks	239
7.8	Patterns	243
7.9	Events and Event patterns	252
7.10	Conclusions	260
8	Synthesis, II: introduction to basic real-time techniques	261
8.1	Oscillators and tables	261
8.1.1	Synthesis by sampling	269
8.1.2	Resampling and interpolation	271
8.2	Direct generation	275
8.2.1	Synthesis by fixed waveform	276
8.2.2	Modulation	277
8.2.3	Ring and Amplitude modulation	278
8.2.4	Ring modulation as a processing technique	280
8.2.5	Frequency modulation	285
8.2.6	C:M ratio	288
8.2.7	Waveshaping	292
8.3	Spectral modelling	297
8.3.1	Additive synthesis	297
8.3.2	Subtractive synthesis	305
8.3.3	Analysis and resynthesis: Phase vocoder	311
8.4	Physical Modeling	319
8.5	Time-based methods	327
8.5.1	Granular synthesis	328
8.5.2	Techniques based on the direct generation of the waveform	331
8.6	Conclusions	335

9	Communication	337
9.1	From server to client: use of control buses	337
9.2	From server to client: use of OSC messages	341
9.3	OSC to and from other applications	346
9.4	The MIDI protocol	349
9.5	Reading and writing: File	353
9.6	Pipe	359
9.7	SerialPort	362
9.8	Conclusions	365

## Foreword

My first encounter with SuperCollider dates back to 2002, thanks to my friend Hairy Vogel, one of its first (and bold) users. At that time, I remember being deeply impressed by the sound quality, the seamless integration between audio synthesis and algorithmic composition, the native real-time operating mode. So, I decided to buy an Apple computer, as SuperCollider 2 was working on MacOS9 systems only, while SuperCollider 3, that had just become open source, was still an unstable release, porting to Linux had just begun (as far as I can remember) and there were no plans at all for a Windows version...But in 2002 I was lacking some basic skills to be productive on SuperCollider, so I left it momentarily, to get back to it in 2005. In 2008 I switched to SuperCollider in my class for the Multimedia and Arts program (DAMS) at the University of Turin. I was not able to find a basic, yet comprehensive resource to use for teaching. Comprehensive of what? This is of course the main point. My class is a basic introduction to computer music, so I was in need of reference for both some basic notions in DSP *and* SuperCollider. Still, I was confident that the latter was the apt tool to approach the former. Yet, introducing SC is to also introduce computer languages in general and certain notions concerning computer science *tout court* (e.g. the client/network architecture). That is why I decided to write this book the scope of which is, consequently, too broad to offer completeness in any of each subjects. From a very personal perspective, I have to confess that I have tried to write the book that I wished to have while starting with SuperCollider. My hope is that someone might be in need of it as I was.

Originally written in Italian in 2008 in an electronic only version, the book has been substantially re-edited and updated to account for the SC 3.7 version in 2015, and then, revised and translated into English in 2016 to be published in a printed version thanks to Logos Verlag. It has been translated into English

by myself and Marinos Koutsomichalis, thanks also to the support of the SuperCollider community. A crucial help on language and content revision has been provided by Joe Higham and Joshua Parmenter. I am deeply thankful to Marinos, Joe and Josh for their work.

SuperCollider has a strong, supporting and passionate community. Without it, my journey with SC probably would have ended very soon. So, I am profoundly indebted to all its members. Finally, a special “grazie” to James McCartney to have his ideas supercollide in his work.

Ciriè, Turin, May 27, 2016