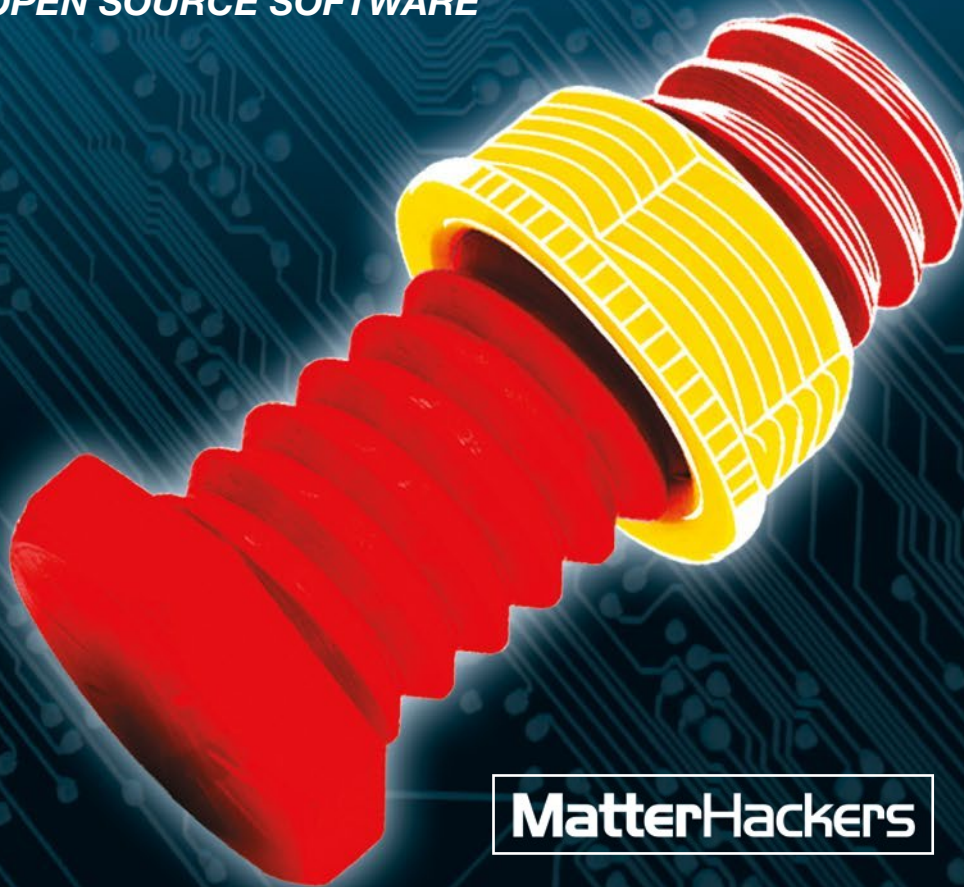




TECHNOLOGY IN ACTION™

3D Printing with MatterControl

**STREAMLINE THE 3D PRINTING PROCESS
WITH OPEN SOURCE SOFTWARE**



MatterHackers

Joan Horvath and Rich Cameron

3D Printing with MatterControl



Joan Horvath
Rich Cameron

Apress®

3D Printing with MatterControl

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To the MatterHackers team, for believing in open source software

Contents at a Glance

- About the Authors.....xv
- Acknowledgments.....xvii
- Introductionxix
- Part I: The 3D-Printing Ecosystem..... 1
 - Chapter 1: The Desktop 3D Printer 3
 - Chapter 2: What Is MatterControl? 15
 - Chapter 3: Downloading and Configuring MatterControl..... 25
- Part II: The 3D-Printing Process 35
 - Chapter 4: Making a 3D Model 37
 - Chapter 5: Slicing a 3D Model 49
 - Chapter 6: Controlling Your 3D Printer 71
 - Chapter 7: Material Considerations..... 85
 - Chapter 8: Special Cases 99
- Part III: Your Printer at Work 111
 - Chapter 9: File and Settings Management, and the Touch Tablet..... 113
 - Chapter 10: Case Studies and Classroom Tips 121
 - Chapter 11: MatterControl Plugins 143

■ **Chapter 12: Troubleshooting and Post-processing..... 149**

■ **Appendix A: Supported Printer Manufacturers 163**

■ **Appendix B: Links..... 165**

Index..... 169

Contents

- About the Authors.....xv
- Acknowledgments.....xvii
- Introductionxix
- Part I: The 3D-Printing Ecosystem..... 1
- Chapter 1: The Desktop 3D Printer 3
 - What Is 3D Printing?..... 3
 - Commercial 3D Printers..... 3
 - Desktop 3D Printers..... 4
 - Desktop 3D-Printer Hardware 7
 - Types of Filament-Based 3D Printers 7
 - Cartesian Printers..... 7
 - Non-Cartesian Printers 9
 - 3D Printer Options 11
 - Heated Beds 11
 - Multiple Extruders 11
 - Electronics Options..... 11
 - Open Source..... 12
 - Summary..... 13
- Chapter 2: What Is MatterControl? 15
 - The 3D-Printing Workflow 15
 - Step 1. Obtain a 3D Model..... 17
 - Step 2. Slice the 3D Model 18
 - Step 3. Reviewing the Sliced File and Printing..... 19

MatterControl's Capabilities	21
Using an SD Card	22
The MatterControl Touch Tablet	22
A Note about 3D Print Durations	23
Summary	23
■ Chapter 3: Downloading and Configuring MatterControl	25
Getting Started Using MatterControl	26
MatterControl Home Screen	26
OPTIONS Menus	30
Hardware Settings	32
Cloud Settings	32
Application Settings	33
The MatterControl Touch Tablet	34
Summary	34
■ Part II: The 3D-Printing Process	35
■ Chapter 4: Making a 3D Model	37
Where to Get 3D Models	37
Scanning a Model	37
Downloading and Modifying Existing Models	39
Creating a 3D Model from Scratch	40
Using a 3D-Modeling Program	40
Types of 3D-Modeling Software	40
Options for Getting Started Quickly	42
Programs for Specific Applications	45
Design Considerations	47
Complexity Is Free (but Simplicity May Not Be)	47
Speed vs. Customization	47
Summary	48

■ Chapter 5: Slicing a 3D Model	49
What Is “Slicing”?	49
3D Printing as Cooking	50
The Physicality of 3D Printing.....	50
3D Printing Design Rules	51
Slicing a Model Using MatterControl	52
Picking One of the Slice Engines.....	52
Running the Program.....	52
Changing the Slice Engine Settings.....	54
Layer-by-Layer Preview	55
Saving a File to Be Printed	56
Slice Engine Settings and What They Mean	56
Starting a Print and Getting a Model to Stick to the Platform.....	57
Supporting and Orienting a Model.....	60
Bridging	63
Tolerances	63
Speed.....	65
Managing Internal Open Space	65
Details, Details: Retraction.....	68
Learning More	69
Summary.....	69
■ Chapter 6: Controlling Your 3D Printer	71
G-code and Firmware.....	71
Understanding G-code	72
M (Machine) Codes	72
Using MatterControl to Control Your Printer	73
Connecting to Your Printer and Starting a Print.....	73
When a Print Starts.....	75
During a Print.....	75
When a Print Finishes Normally.....	77
Restarting or Shutting Off the Printer	77

Managing and Debugging Problems	78
G-code Terminal.....	78
Stopping a Print.....	79
Changing Filament.....	79
Changing Temperatures During a Print.....	80
Basic Hardware Troubleshooting	81
Running from an SD Card.....	82
Summary	83
■ Chapter 7: Material Considerations.....	85
Filament Quality Control	86
Filament-Related Settings in MatterControl.....	87
Selecting and Using a Filament.....	90
Directional Strength.....	91
The Right Print Bed	91
Temperature and Speed Settings	93
Will My Filament Spool Run Out During My Print?.....	94
Filament Materials	94
Polylactic Acid (PLA)	94
Filled Materials	94
Acrylonitrile Butadiene Styrene (ABS)	95
Nylon	95
Polyethylene Terephthalate (PET)	96
Polycarbonate.....	96
Thermoplastic Elastomers (TPEs).....	96
Dissolvable Support Materials	96
Summary	97
■ Chapter 8: Special Cases	99
Printing Hollow Objects.....	99
Printing Vases	102

Multiple Extruders	103
Dual-Extruder Printing with Two Different Materials	104
Using MatterControl with a Dual-Extruder Printer	105
Summary	109
■ Part III: Your Printer at Work	111
■ Chapter 9: File and Settings Management, and the Touch Tablet.....	113
File Management: The Queue	113
The MatterControl Library	114
Settings Management: Pre-sets	116
The MatterControl Touch Tablet.....	118
Creating a MatterHackers Account	118
Running a Printer from a Touch	118
The Camera	118
Summary	119
■ Chapter 10: Case Studies and Classroom Tips	121
Simple Print.....	122
Steps in MatterControl for the Simple Model	123
Typical Model Mistakes and How to Avoid Them	127
Printing with Support	128
Printing Fine Details	130
Text on a Print.....	130
Effects of Print Orientation	131
Unusual Slicing: The Quick-Print Gear Bearing	134
Classroom 3D-Printing Observations	137
Learning 3D Design	137
When to Use a 3D Printer.....	140
Overcoming Challenges	140
Summary	141

- **Chapter 11: MatterControl Plugins 143**
 - Existing Plugins 143
 - Text Creator 144
 - Image Converter 145
 - Summary 148
- **Chapter 12: Troubleshooting and Post-processing..... 149**
 - How to Unclog a Nozzle 150
 - Cold Pull..... 150
 - Other Unclogging Techniques 153
 - How to Minimize Stringing 153
 - How to Print Computationally Complex Objects 155
 - How to Print Physically Big Objects..... 156
 - Objects That Are Too Long for the Build Platform 156
 - Objects That Are Too Big in More Than One Dimension 157
 - Tips on Removing Support 158
 - Sanding, Chemical Smoothing, Painting, and Dyeing 159
 - Sanding..... 159
 - Smoothing and Bonding ABS with Acetone 160
 - Painting ABS and PLA 160
 - Dyeing Nylon..... 160
 - Some Final Thoughts..... 160
 - Going from a 3D Print to a Metal Cast 160
 - Other Printer Technologies 161
 - Applications 161
 - Going Forward 162
 - Summary 162

■ **Appendix A: Supported Printer Manufacturers 163**

■ **Appendix B: Links..... 165**

 About the Authors..... 165

 Chapter 1: The Desktop 3D Printer 165

 Chapter 2: What Is MatterControl? 165

 Chapter 3: Installing and Setting Up Matter Control 165

 Chapter 4: Making a 3D Model 166

 Chapter 5: Slicing a 3D Model – no links 166

 Chapter 6: Controlling Your 3D Printer..... 166

 Chapter 7: Material Considerations 166

 Chapter 8: Special Cases & Chapter 9: File and Settings Management and
 the Touch Table - no links 166

 Chapter 10: Case Studies and Classroom Tips 167

 Chapter 11: MatterControl Plugins 167

 Chapter 12: Troubleshooting and Post-Processing..... 167

Index..... 169

About the Authors



Joan Horvath and Rich Cameron (known online as “Whosawhatsis”) are the cofounders of Nonscriptum LLC based in Pasadena, California. Nonscriptum consults for educational and scientific users in the areas of 3D printing and maker technologies. This book is their latest collaboration, following their earlier works *Mastering 3D Printing* (Apress, 2015) and *The New Shop Class: Getting Started with 3D Printing, Arduino, and Wearable Tech* (Apress, 2015). Starting in January 2016, they will also be teaching online classes in 3D printing for LERN Network’s U Got Class continuing education program. Links for all of the above are on their website, www.nonscriptum.com.

In addition work with Rich, Joan also has an appointment as Core Adjunct faculty for National University’s College of Letters and Sciences. She has taught at the university level in a variety of institutions, both in Southern California and online. Before she and Rich started Nonscriptum, she held a variety of entrepreneurial positions, including VP of Business Development at a Kickstarter-funded 3D-printer company. Joan started her career with 16 years at the NASA/Caltech Jet Propulsion Laboratory, where she worked in programs including the technology transfer office, the Magellan spacecraft to Venus, and the TOPEX/Poseidon oceanography spacecraft. She holds an undergraduate degree from MIT in Aeronautics and Astronautics and a master’s degree in Engineering from UCLA.

Rich is an experienced open source developer who has been a key member of the RepRap 3D-printer development community for many years. His designs include the original spring/lever extruder mechanism, the RepRap Wallace, and the Deezmaker Bukito portable 3D printer. By building and modifying several of the early open source 3D printers to wrestle unprecedented performance out of them, he has become an expert at maximizing the print quality of filament-based printers. When he’s not busy making every aspect of his own 3D printers better, from slicing software to firmware and hardware, he likes to share that knowledge and experience online so that he can help make everyone else’s printers better too.

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Introduction

The consumer 3D-printing landscape has changed a lot in the past year. Initially in the realm of crowdfunded startups, the printers are now starting to look more and more like consumer electronics devices than hobbyist kits. As with any maturing industry, unfortunately along the way there has been a fracturing of standards. Many one-off proprietary systems are coming on to the market. The open source community has been standing against that trend. This book focuses on MatterControl, a program for using any one of the many printers that conform to open source standards.

3D printing can be defined pretty simply: creating an object by building it up layer by layer—rather than by machining it away the way you would by making something from a block of wood or by squirting something into a mold as you would for injection-molded plastic parts. Making 3D printing work, though, is far from simple. 3D-printer designers can take one of two fundamental approaches. Either they can make their system proprietary (using software and hardware available only to them) and tightly control their ecosystem so that the user does not have to (and, often, cannot) make many changes; or they can accept the complexity, requiring that the user be more sophisticated.

This book is aimed primarily at the latter audience. MatterControl hides some of the complexity from users, but also allows flexibility for the printers that support it. MatterControl comes preloaded with settings for some printers, which makes getting started with those printers particularly simple.

This book is meant to be a self-contained tutorial on consumer 3D printers that run open source software. More specifically, it is a “manual plus” for MatterControl and the ecosystem of open source 3D-printing hardware and software surrounding it. We draw on some of the material from the earlier book *Mastering 3D Printing* (Apress, 2014). That book for the most part avoided screenshots and step-by-step instructions because when it was written (about a year before this book), most software interfaces were too much in flux to include in a traditional book. With the maturing of the industry and its software, it is now possible to create more of a step-by-step guide to using particular software. Details may change and features may be added, of course. By the time you read this, MatterControl may have evolved a little, but the fundamentals are now in place. This book is mostly software-focused; if you are more interested in the hardware too and post-processing, you might consider also investing in *Mastering 3D Printing*.

This book can be used as a textbook for a semester-length class or university extension certificate series covering 3D printing and its applications, particularly one focusing on K–12 educators. It might be paired with an in-depth class on 3D computer-aided design (CAD) software for students interested in engineering and industrial or product design, or a group planning on starting with an open source RepRap printer that they plan to modify for specialized applications. Similarly, this book might be paired with a text covering one of the sculptural 3D-modeling programs for students developing skills in 3D animation or fine art.

Part 1 (Chapters 1–3) of the book gives background on the history of these printers, talks about how the hardware works, and introduces the MatterControl software, including downloading and configuring it for a particular printer. Part 2 (Chapters 4–8) is the nitty-gritty tutorial on the workflow of using a 3D printer: developing a 3D model, slicing it into layers that the printer will create one at a time, and controlling the printer in real time. This part concludes with a discussion of special cases, such as printing something hollow. Part 3 (Chapters 9–12) talks about how to put your 3D printer to work, with some case studies,

a discussion of classroom lessons learned, and ways of post-processing your 3D print to improve the surface finish. This part reviews creating larger projects and troubleshooting, too. To round out the book, we have two appendices. Appendix A lists the 3D printers currently supported by MatterControl, and Appendix B gathers up all the links referenced in the book so that you can have them in one place.

We hope you enjoy this book and that it launches you on many adventures in 3D printing. As the software and hardware begin slowly mature, we know you will be able to invent and prototype as never before, and we hope in some small way that we can speed you along that road.

PART I



The 3D-Printing Ecosystem

Chapter [1](#) introduces you to desktop 3D printers. Then we move on to talking you through what the MatterControl program is in Chapter [2](#). Finally, in Chapter [3](#), we walk you through setting up and installing MatterControl so that you are ready for the 3D printing-workflow in the chapters that follow.