Digital Control in Power Electronics

2nd Edition

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Simone Buso and Paolo Mattavelli
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ABSTRACT

This book presents the reader, whether an electrical engineering student in power electronics or a design engineer, a selection of power converter control problems and their basic digital solutions, based on the most widespread digital control techniques. The presentation is primarily focused on different applications of the same power converter topology, the half-bridge voltage source inverter, considered both in its single- and three-phase implementation. This is chosen as the test case because, besides being simple and well known, it allows the discussion of a significant spectrum of the most frequently encountered digital control applications in power electronics, from digital pulse width modulation (DPWM) and space vector modulation (SVM), to inverter output current and voltage control, ending with the relatively more complex VSI applications related to the so called *smart-grid* scenario. This book aims to serve two purposes: (1) to give a basic, introductory knowledge of the digital control techniques applied to power converters; and (2) to raise the interest for discrete time control theory, stimulating new developments in its application to switching power converters.

KEYWORDS

digital control in power electronics, discrete time control theory, half-bridge voltage source converters, power converters, power electronics

Digital Control in Power Electronics is dedicated to the memory of
Professor Luigi Malesani,
the founder of the PEL group and our unforgettable maestro.

Contents

Preface xiii

Acknowledgments xv

1 Introduction 1

2 The Test Bench: A Single-Phase Voltage Source Inverter 7

2.1 The Voltage Source Inverter 7
2.1.1 Fundamental Components 7
2.1.2 Required Additional Electronics: Driving and Sensing 9
2.1.3 Principle of Operation 9
2.1.4 Dead-Times 11
2.2 Low-Level Control of the Voltage Source Inverter: PWM Modulation 13
2.2.1 Analog PWM: the Naturally Sampled Implementation 14
2.2.2 Digital PWM: the Uniformly Sampled Implementation 17
2.2.3 Single Update and Double Update PWM Modes 21
2.2.4 Minimization of Modulator Delay: a Strong Motivation for Multi-Sampling 23
2.3 Analog Control Approaches 24
2.3.1 Linear Current Control: PI Solution 25
2.3.2 Nonlinear Current Control: Hysteresis Control 31
References 33

3 Digital Current Mode Control 35

3.1 Requirements of the Digital Controller 35
3.1.1 Signal Conditioning and Sampling 35
3.1.2 Synchronization Between Sampling and PWM 40
3.1.3 Quantization Noise and Arithmetic Noise 41
3.1.4 Limit Cycle Oscillations 44
3.2 Basic Digital Current Control Implementations 47
3.2.1 The Proportional Integral Controller: Overview 48
3.2.2 Simplified Dynamic Model of Delays 50

3.2.3 The Proportional Integral Controller: Discretization Strategies 52
3.2.4 Effects of the Computation Delay 57
3.2.5 Derivation of a Discrete Time Domain Converter Dynamic Model 60
3.2.6 Minimization of the Computation Delay 65
3.2.7 The Predictive Controller 67
References 83

4 Multi-Sampled Current Controllers 85
4.1 Oversampled PI Current Controller 87
4.1.1 Small-Signal Frequency Response 90
4.2 Oversampled Predictive Current Controller 91
4.2.1 Closed-Loop Transfer Function Derivation 96
4.2.2 Small-Signal Frequency Response 97
4.3 Digital, Fixed Frequency Hysteresis Current Controller 98
4.3.1 Switching Frequency Stabilization 98
4.3.2 Controller Operation 100
4.3.3 Small-Signal Frequency Response 108
4.4 Large-Signal Response Test 108
4.5 FPGA Chip Utilization 113
4.6 Multi-Sampled Current Controllers: Conclusions 113
References 114

5 Extension to Three-Phase Inverters 117
5.1 The $\alpha\beta$ Transformation 117
5.2 Space Vector Modulation 120
5.2.1 Space Vector Modulation-Based Controllers 127
5.3 The Rotating Reference Frame Current Controller 130
5.3.1 Park's Transformation 130
5.3.2 Design of a Rotating Reference Frame PI Current Controller 133
5.3.3 A Different Implementation of the Rotating Reference Frame PI Current Controller 135
References 144

6 External Control Loops 147
6.1 Modeling the Internal Current Loop 147
6.2 Design of Voltage Controllers 151
6.2.1 Possible Strategies: Large and Narrow Bandwidth Controllers 152

6.3 Large Bandwidth Controllers . . . 153
6.3.1 PI Controller . . . 153
6.3.2 The Predictive Controller . . . 161
6.4 Narrow Bandwidth Controllers . . . 169
6.4.1 The DFT Filter-Based Voltage Controller . . . 176
6.5 Other Applications of the Current Controlled VSI . . . 181
6.5.1 The Controlled Rectifier . . . 183
6.5.2 The Active Power Filter . . . 185
References . . . 187

7 New digital control paradigms . . . 189
7.1 Flexibility vs. Performance . . . 189
7.2 Flexibility and Performance . . . 190
7.3 Distributed Generation Control Architectures . . . 191
7.3.1 VSIs in Distributed Generation Grids . . . 192
7.3.2 Control System Organization . . . 192
7.3.3 Control Architecture Implementation . . . 194
7.4 Controller Validation . . . 200
7.4.1 Simulink© Model . . . 201
7.4.2 Real-Time, Hardware-in-the-Loop Simulation . . . 201
7.4.3 Mitigation of Real-Time Simulation Artifacts . . . 205
7.4.4 Experimental Tests . . . 207
7.5 Closing Remarks . . . 209
References . . . 210

Authors' Biographies . . . 213

Preface for the Second Edition

After more than eight years from its first publication, we felt it was about time to revise and update the material presented in this book. In preparing the revision, we did not want to change the introductory, concise style of the first edition, that, in our opinion, has been, and still is, one of the strong sides of the book. Yet, we wanted to provide the reader with an updated, fresher image of digital control applications in power electronics.

A few of the trends that had been identified some years ago, such as the evolution of digital controllers from software to hardware implementations, have indeed become standard practice, while new, partially unforeseen, application fields have emerged, like, among all, the distributed generation and "smart-grid" ones. Without trying to cover these topics exhaustively, which would have gone beyond the introductory scope of the book, we still took the chance to present, with this second edition, new information and experimental data from our more recent studies related to them.

In doing so, we have compiled a couple of new chapters, one dedicated to the multi-sampled versions of the basic current controller implementations, that represented the core of the first edition, and the second to the complex digital control architectures that characterize the above mentioned, emerging application fields. In addition, we have decided to revise the original discussion of basic current controllers, essentially to provide experimental verification data, corroborating the original simulation-based exemplifications, and, in our opinion, improving the quality of the presentation.

Simone Buso and Paolo Mattavelli
April 2015

Acknowledgments

This book has been written on the basis of the authors' expertise, that has been almost fully acquired within the power electronics research group (PEL group) of the University of Padova. Without the help and dedication of the people that have worked and are still working in the team, the writing of the book would have been altogether impossible. Therefore, the authors would like to acknowledge and thank everybody at PEL group for the time spent together in creating, discussing, and testing all the ideas presented in this book.

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