

Preface

Here at first, I would like to put down some motivations and general thoughts behind this book. During my past 10 years working period in mixed academic and industry environment, I had many technical discussions and leisure chats with global researchers and electronic engineers, most of them are active pioneers in universities, leading research organizations and international technology companies. I found an interesting fact that majority of them are either “thinkers” (question-raising persons) or “doers” (solution-providing persons), not both at the same time, in other words, the one with nice idea on a topic accompanying a bunch of mathematical equations is not 100% sure whether the idea is fully valid in the real physical world or the one who takes care of building prototype systems as daily basis does not have much visibility of new emerging ideas. This is not surprised, there is gap, a relatively huge one, between emerging technology topics and cutting-edge physical implementations, this can be considered as cross-domain activity, it happens either because the “thinkers” or the “doers” are not interested in the other direction or because at particular period of the career, they could not move on due to the lack of time or simply due to the absence of a proper/attractive guide book or some readings on that topic.

This book aims at building a bridge to reduce the gap between “thinking-person” and “doing-person” for researchers, engineers, and senior university students who are currently working or are just entering in the hardware wireless system signal processing discipline, a cross-discipline of Wireless Communications, Digital Signal Processing, and Field Programmable Gate Array (FPGA) design. FPGAs, as scalable digital processing platforms, have been widely and heavily used in all types of hardware equipments in the modern wireless mobile networks (like the third generation (3G) and the fourth generation (4G) wireless base stations and corresponding infrastructures) and in our opinion they will be more densely utilized in the emerging fifth generation (5G) wireless systems.

Psychologically, we do not learn new things in an exactly organized sequential way, for example, very few people mastered the alphabets in an exact A to Z manner, and we actually project those letters to our brain in a kind of guided random manner according to our own interests and pre-acquired experience. This is

why quite a large percentage of our higher education systems have started trying to create customized learning plans for different students with different backgrounds. Similarly in the technology R&D organizations, there is a natural need for promoting research and creating new ideas by cross-discipline approaches. How to make the best use of multi-domain knowledge is not a simple discussion work, it is a piece of art with innovative thinking and solid actions behind. Moreover, validated by scientific research, the majority of people are visual learners, which means a self-explained graphic illustration in a book is much better to tell an attractive technical story than just reading 500 recondite words.

Therefore in this book, at first I would like to introduce the fundamentals of using FPGA for digital signal processing purpose (Chap. 2), and then I will use one of the most important functions (i.e., linear convolution) in the signal processing society as an example, to illustrate what is convolution, why we need that in the wireless systems, and how it is working in the real world (Chap. 3). I will illustrate (by many figures and drawings besides explanations) how to quickly transfer this signal processing idea to a robust working digital system implementation on the FPGAs. With easy-to-read psychotechnical analysis, hands-on procedures and graphic illustrations, the reader will quickly grab the basic technical skills. And then, in the latter part of the book, I will move to detailed advanced topics including FPGA-based nonlinear convolution (Chap. 4) and FPGA-based fast linear convolution (Chap. 5) that are tightly associated with many attractive wireless communication applications, particularly the digital predistortion (DPD) applications for high efficient modern wireless transceivers and spatial multiplexing applications for the forthcoming 5G massive MIMO wireless networks. At the end, I will illustrate how to quickly and properly evaluate the FPGA-based DSP functions in a software (SW) & hardware (HW) co-operated platform (Chap. 6), which has been successfully utilized in many applications.

And thanks for choosing this book along your professional road, hope you will enjoy the contents and learn something you need. If you have any suggestions, comments, or questions with regard to the book and the corresponding topics, please contact me at DR.LEI.GUAN@GMAIL.COM.

FPGA-based Digital Convolution for Wireless
Applications

Guan, L.

2017, XVII, 151 p. 128 illus., 61 illus. in color.,
Hardcover

ISBN: 978-3-319-51999-9