Preface

The advent of wireless communications of the last decades has spun an exponential increase in the number of users, hardware, and data rates. On the brink of the fifth wave of wireless system development (5G), it is forecasted that the world will become even more interconnected at ever-growing speeds. The radio front-end circuit designer needs to be prepared to handle this imminent wave. This translates to the designer being ready to interpret quickly any wireless standard.

This book brings to light a new approach aimed at finding the optimal design path for next-gen software-defined radio receiver front-ends (SDRXs): a standard-independent structured design methodology, which is setting the receiver architecture and electrical specifications and meets the submicron CMOS transistor-level implementation constraints that drive the topologies of the SDRX building blocks.

In my opinion, in today's design world, the main design challenges reside at system level, as significant progress has been made to improve the key RF and mixed-signal circuits performance.

First, I find a lack of a systematic approach in the system-level analysis of SDRXs and create a standard-independent, systematic methodology to help derive the receiver key electrical specifications. The novelty consists in the fact that the developed methodology empowers the designer to tackle the multi-standard environment in a parallel way rather than serially, as is the case with previous published works. This is a critical feature for any design methodology targeting 5G circuits and systems. The methodology is based on manual analysis that suits best an intuitive understanding, as this is the most efficient way for a designer to have the grasp on the design process.

Throughout the book, the SDRX design follows the key wireless standards of the moment (i.e., GSM, WCDMA, LTE, Bluetooth, WLAN), since a receiver compatible with these standards is the most likely candidate for the first design iteration in a 5G deployment. Thus, a multi-standard SDRX is constructed. Due to the newly developed standard-independent system-driven design methodology, the designer is enabled to handle efficiently the large amount of information provided in the wireless standards and to remain in control of the system being designed. Moreover,

this methodology has the advantage in that it can be used very effectively in the case of the new, soon-to-be-developed, wireless standards of the 5G wave.

Hence it is shown that direct conversion architecture is the most suited choice for the SDRX. Further on, I demonstrate the fundamental choice the designer has to make is the optimal channel selection: how much of the blockers/interferers will be filtered in the analog domain and how much will remain to be filtered in the digital domain. Also this opened the path for the novel "smart" gain−noise−linearity partitioning tailored toward SDRXs that optimally leverages the extreme reception conditions specific to the wireless environment.

With the new analysis methodology, this book lays down a concept in creating standardized tools for tomorrow's SDRX designers. Basically, these tools represent the compass used to explore the SDRX domain map.

The introduction of the new and efficient tool *the generic blockers diagram*, together with the newly defined figure of merit (FOM) FOM_{CHS}, enabled the proper evaluation of the key trade-off that shapes the receiver design: the trade-off between the receiver low pass filter (LPF) area and its analog-to-digital converter (ADC) power consumption; thus, the optimum filter partitioning between the SDRX baseband analog LPF and the digital filter following the ADC is found in one single plot.

One of the key features of the developed system-level analysis is that the direct sampling architecture is treated as a particular case of mixer-based direct conversion architecture. Thus, given a power consumption budget, one can evaluate specifically, by considering the ADC performance characteristics and the corresponding blocker diagram, how much filtering is required on the receive path.

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