Teaching analog IC design: how to learn an elephant to dance

INVITED TALK

Georges Gielen
ESAT-MICAS, Department of Electrical Engineering
Katholieke Universiteit Leuven, Belgium
gielen@esat.kuleuven.be

With the evolution towards nanometer CMOS technologies, the design of complex Systems on a Chip (SoC) or Systems in a Package (SiP) is emerging in consumer-market applications such as telecom and multimedia. These highly integrated systems are increasingly mixed-signal designs, embedding high-performance analog or mixed-signal blocks and possibly sensitive RF frontends together with complex digital circuitry (multiple processors, some logic blocks, and several large memory blocks) on the same chip (or stack of chips). In addition, the growth of wireless services and other telecom applications with ever increasing bandwidth needs increases the need for low-cost highly integrated solutions with very demanding performance specifications operating at ever higher speeds. This requires the development of intelligent front-end architectures that get around the physical limitations posed by the semiconductor technology. Furthermore, also more traditional application domains like automotive or instrumentation show an increasing trend in integrating analog sensor/actuator interfaces with digital electronics. And the emerging fields of miniaturized and possibly networked and/or implanted biomedical devices as well as sensor networks promises to be an even larger market for integrated mixed-signal systems.

As a result, IC design engineers who want to design and build these highly integrated systems need to have on the one hand sufficient knowledge from the application domains (telecommunications, multimedia, computing) and on the other hand ample knowledge about IC design techniques ranging from system level to circuit design, both analog, digital and RF, all the way down to device and technology knowledge, and this in combination with proper knowledge of the supporting CAD tools and design methodologies. In addition, they need to master designing embedded software as this becomes a growing component of many electronic systems. Hence, future design engineers need to combine all this knowledge in their curriculum. Only in this way the capabilities offered by the emerging technologies (CMOS or beyond CMOS) can be fully utilized to improve the performance of the systems and to conceive and build novel applications, driven by societal needs of the people.

While many engineering schools are abandoning or minimizing the teaching of device and circuit design skills and focus mainly on digital system design and software, the above is plea to the contrary. Of course, depending on the interests and the specialization (for instance system architect

versus IC circuit designer, software developer versus technology engineer), not all aspects should be covered to the same depth and some fields should be emphasized more than others. This invited talk will describe how the Electrical Engineering – ICT program at the Katholieke Universiteit Leuven (K.U.Leuven) (**http://www.esat.kuleuven.be/education/master/ee/**) tries to balance these different fields in a global program that aims at educating the design engineer of the future. Also the role of hands-on design projects in this education process will be illustrated. Rather than teaching implementation-ignorant elephants, we want them to learn to dance and design elegant, high-performing systems needed by society.