Ultra-low power and ultra-low voltage analog front-ends for non-invasive wearable sensors

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Abstract

Technical advances in the fabrication of integrated circuits and wireless communication technologies have enabled the development of wearable biomedical devices. In particular, body area networks (BANs) formed by self-powered sensors located on the human body, or near it, are a highly promising concept of eHealth applications over the coming decades. However, the successful realization of this vision requires innovative solutions to remove the critical technological obstacles to realize the wireless sensor nodes. One of the main challenges is to reduce the power consumption of the wearable sensor in order to be compatible with energy densities achieved using ultra-low power energy harvesters. On the other hand, reduction of the feature size of modern CMOS technologies requires supply voltages to drop to values lower than 1 V. This trend has the detrimental consequence of limiting the dynamic range of analog subsections. Furthermore, an ultra-low voltage supply does not necessarily decrease the dissipation of the analog integrated circuits because it often leads to more complex designs, resulting in additional quiescent current.

This talk aims to present methods and techniques that allow the design of analog and mixed-signal integrated circuits, seeking for significant advantages when they are jointly used for implementing ultra-low power and ultra-low voltage analog front-end circuits in CMOS technologies for biomedical signal conditioning, with special emphasis on bioelectrical signals with high bandwidth. At the same time, since many emerging non-invasive measurement techniques related to the physiological status of individuals rely on bioelectrical impedance spectroscopy (BIS), we will focus on the difficulties presented by CMOS technologies for chip-scale integration of BIS readout electronics.