Application oriented research for integrated circuit technologies and intelligent medical devices

By Zhihua Wang

Abstract:

To do research in the field of engineering in an university requires not only pursuing excellence objective, but also focusing on summarizing and refining academic achievements, and more importantly, paying attention to the application of research results. Regardless of the field and aspect, researchers should aspire to do the best work in the world and strive to make their achievements known to international peers. Researchers need to clarify the difference between research objectives and research results, and recognize that the source of innovation is application demand, and long-term persistence is the key to achieving successful. The research experiences of many renowned scholars both d demonstrate and proof this conclusion.

The research of audience focuses on the field of information science, specifically the integrated circuits which is the background of information science. As the greatest invention in technological history, integrated circuits cannot be replaced in the future. In fact, from the history of technological development, major inventions such as the steam engine and electricity have never been replaced. The birth of integrated circuits has brought the information age to humanity, and its importance is beyond doubt. Integrated circuits are composed of interconnected transistors, which can achieve all the operations needed by humans and are the core support of the massive information industry. Therefore, there is no possibility of replacing integrated circuits in the future.

Over the past fifty years, the main driving force for the development of integrated circuits has come from the relentless pursuit of "to make computers smaller and smarter". In the future, the miniaturization and intelligence of medical devices will become a new driving force for the development of integrated circuits. Of course, medical devices that can drive the advancement of integrated circuit technology should have two characteristics: one is centered around electronic technology, and the other is having sufficient market volume.

This report presents our research in intelligent medical devices with the neuromodulators and hearing aids as examples. These medical devices are limited in space, energy, and require long working and standby times, as well as intelligent signal processing and adaptive capabilities. Therefore, the implementation using integrated circuits has become an inevitable path for the realization of these medical devices. The intelligence and miniaturization of these medical devices can continuously promote innovation in integrated circuits in areas such as fabrication, sensing technology, and energy efficiency optimization. Our research is not limited to the discovery of new knowledge and the invention of new technologies, but also includes the practice of productization and industrialization of technological achievements. The research results fully demonstrate the impact of interdisciplinary collaboration and application-oriented development models on scientific research.

Biography：

Zhihua Wang (Fellow of IEEE. Fellow of Chinese Institute of Electronics, Fellow of China Institute of Communications) received the B.S., M.S., and Ph.D. degrees in electronic engineering from Tsinghua University, Beijing, China, in 1983, 1985, and 1990, respectively. Since 1997, he has been a Full Professor with Tsinghua University. Since 2000, he has been the Deputy Director of the Institute of Microelectronics. From 1992 to 1993, he was a Visiting Scholar at CMU. He was a Visiting free Researcher at KU Leuven from 1993 to 1994. From September 2014 to March 2015, he was a Visiting Professor at HKUST. He has coauthored 13 books/chapters, over 299 (677) articles in international journals (conferences), over 253(29) articles in Chinese journals (conferences), and holds 139 Chinese and ten U.S. patents. His current research mainly focuses on CMOS RFIC and biomedical applications, involving RFID, PLL, low-power wireless transceivers, and smart clinic equipment combined with leading edge RFIC and digital image processing techniques. He was an AdCom Member of the IEEE SSCS from 2016 to 2019. He was a Technology Program Committee Member of the IEEE ISSCC from 2005 to 2011. Since 2005, he was a Steering Committee Member of the IEEE A-SSCC. He has served as the Chairman of IEEE SSCS Beijing Chapter from 1999 to 2009. He was the Technical Program Chair for A-SSCC 2013. He was a Guest Editor for IEEE JOURNAL OF SOLID-STATE CIRCUITS (JSSC) Special Issue in December 2006, December 2009, and November 2014. During 2019-2020, he has been an Associate Editor in Chief of IEEE OPEN JOURNAL OF CIRCUITS AND SYSTEMS. He had been an Associate Editor of IEEE TRANSACTIONS ON CIRCUITS AND SYSTEMS—I: REGULAR PAPERS during 2016-2019, and IEEE TRANSACTIONS ON CIRCUITS AND SYSTEMS—II: EXPRESS BRIEFS during 2010-2013, IEEE TRANSACTIONS ON BIOMEDICAL CIRCUITS AND SYSTEMS (BioCAS) during 2008-2015, and other administrative/expert committee positions in China’s national science and technology projects. From 2018 to 2019, he was an IEEE SSCS Distinguished Lecturer. From 2020-2022, he has was an IEEE CASS Distinguished Lecturer.