Preface

This volume 2 of CHIPS 2020 is a follow-up on CHIPS 2020, published in 2012, which was initiated by the 50th anniversary 2009 of the integrated circuit patent by Robert Noyce. It is indicative of the unique pace of progress of integrated circuits that, from their conception in 1959, it took only six years until 1965 that Noyce's colleague and friend Gordon Moore envisioned the unparalleled potential that these chips could double their complexity and functionality every 18 months. The driving force for this rate of innovation and market growth was that two-dimensional patterning of each new chip generation would allow to double the number of transistors per cm^2, establishing the famous nanometer road map.

As we celebrate the 50th anniversary of **Moore's law**, this nanometer road map has finally reached its limit at about 14 nm, and there are signs of postponing Gigafactory investments in 10-nm facilities. Moore's law on a two-dimensional nanometer scale is dead. But the key message of the 2012 issue of CHIPS 2020 is that Moore-scale exponential growth can continue with quantum steps in the energy efficiency and in the functional efficiency of nanochips.

I am very grateful to the authors of the 2012 chapters that they wrote highly attractive updates on their specific subjects. And we are particularly fortunate that the most distinguished experts on the key innovations for the next decade wrote highly integrated chapters on their fields: Toshiaki Masuhara, recipient of the 2000 IEEE Millennium Medal, acted as the President of the Japanese Project on Low-Power Electronics (LEAP), and he put together the final results on this most holistic research and development program for our book. Zvi Or-Bach, a lifetime creator of highly innovative technology companies and a member of the executive committee of the most promising new IEEE Cooperation S3S, Silicon-on-Insulator, 3D Integration, and Sub-Threshold MOS, wrote the most comprehensive and most realistic overview on monolithic 3D integration. Ulrich Rueckert, with a 30-year record on neural networks and a member of the European "Human Brain Project," wrote a unique assessment of the present worldwide brain-inspired computing activities. The explosion of the video data, occupying 70 % of the mobile Internet, led us to review the inflationary linear video world, caused by the era of

charge-coupled devices (CCD). The superb efficiency of recording, coding, and compression of high-performance video, inspired by the human visual system (HVS), is covered by Rafal Mantiuk and Karol Myszkowski, world-renowned for their research. We consider effective HVS-inspired video as the disruptive innovation to save the mobile Internet from its breakdown and to supply reliable machine vision for future intelligent man-machine cooperation, a key perspective for nanoelectronics.

We thank our readers for their great interest in the first CHIPS 2020, which encouraged our publisher to support this second volume. Regarding its direction and strategy, I benefitted from inspiring discussions with the physics editor Claus Ascheron and with Angela Lahee, the coordinator of the Frontiers Collection. Technically, I like to thank Nele Reinders of KU Leuven, Belgium, for the friendly communication on their great work on sub-threshold DTG logic. Stefanie Krug took care again of many illustrations. I thank the Springer team for their careful editing.

As in the first CHIPS 2020 of 2012, our presentation keeps an understandable technical level so that the two books together should be helpful to the broad community concerned about nanoelectronics, from students to graduates, educators and researchers, as well as decision makers like managers, investors, and policy makers.

Sindelfingen Bernd Hoefflinger
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