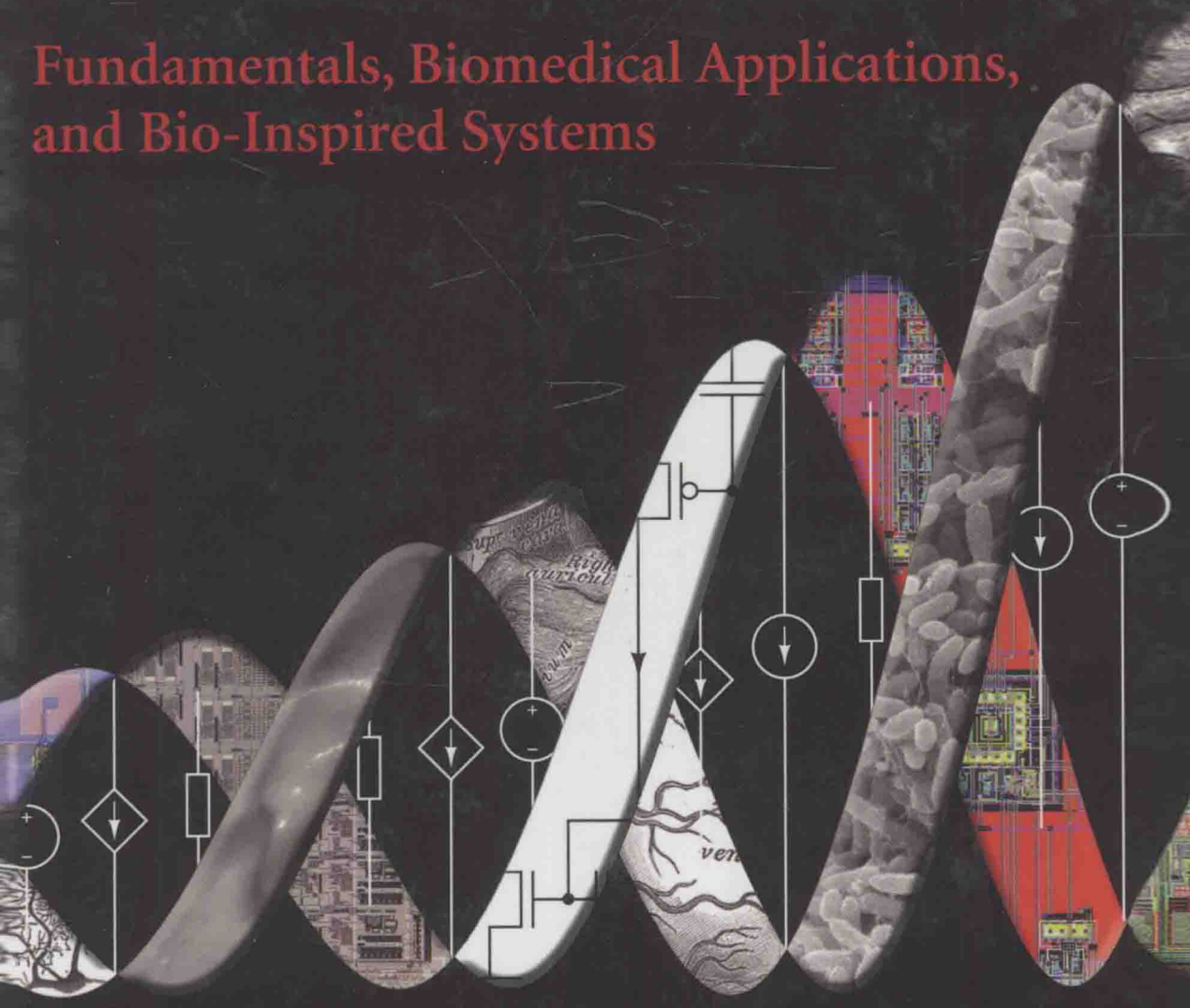
Ultra Low Power Bioelectronics

Fundamentals, Biomedical Applications, and Bio-Inspired Systems



Rahul Sarpeshkar

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Fundamentals, Biomedical Applications, and Bio-inspired Systems

RAHUL SARPESHKAR
Massachusetts Institute of Technology

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Ultra Low Power Bioelectronics

This book provides, for the first time, a broad and deep treatment of the fields of both ultra low power electronics and bioelectronics. It discusses fundamental principles and circuits for ultra low power electronic design and their applications in biomedical systems. It also discusses how ultra energy-efficient cellular and neural systems in biology can inspire revolutionary low power architectures in mixed-signal and RF electronics.

The book presents a unique, unifying view of ultra low power analog and digital electronics and emphasizes the use of the ultra energy-efficient subthreshold regime of transistor operation in both. Chapters on batteries, energy harvesting, and the future of energy provide an understanding of fundamental relationships between energy use and energy generation at small scales and at large scales. A wealth of insights and examples from brain implants, cochlear implants, biomolecular sensing, cardiac devices, and bio-inspired systems make the book useful and engaging for students and practicing engineers.

Rahul Sarpeshkar leads a research group on Bioelectronics at the Massachusetts Institute of Technology (MIT), where he has been a professor since 1999. This book is based on material from a course that Professor Sarpeshkar has taught at MIT for 10 years, where he has received both the Junior Bose Award and the Ruth and Joel Spira Award for excellence in teaching. He has won several awards for his interdisciplinary bioengineering research including the Packard Fellow Award given to outstanding faculty.

To my father, Pandi
who infected me with an enthusiasm and love for science.

To my mother, Nalini
whose boundless love and belief in me form the core of my being.

To my wife, Morgen
whose beauty, sweetness, wisdom, and infinite love empower me to be the man that I am.

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Rahul Sarpeshkar
Cambridge, Massachusetts

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