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Single-photon Avalanche Diode CMOS Image Sensors

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This book gives a detailed and comprehensive overview of single-photon image sensors, with particular emphasis on all the challenges that need to be faced during the implementation of a SPAD-based image sensor with high-pixel density. Constraints such as area occupation and power consumption are therefore central, and several device-level and circuit-level solutions are shown and analyzed in detail; the key building blocks for these special cameras featuring single-photon counting, timestamping, and/or gating capabilities are also thoroughly explained. This book provides examples of the main application fields of SPAD image sensors to help understand the technology potential and introduces the specific electro-optical characterization methodologies required for this new class of sensors. Finally, the latest leading-edge technologies are outlined providing a possible roadmap for next-generation sensors.

Image sensors and optical sensors are nowadays ubiquitous and in continuous evolution, with a constant trend toward increased performance and new functionalities. Extremely high sensitivity down to single-photon detection, wide dynamic range from moonlight to sunlight, time-resolved capability and megapixels resolution are some of the main requirements from different market applications. To address these new and very challenging market requests, a new class of imagers based on single-photon avalanche diode (SPAD) detectors has emerged and is gaining its place in the market.

Single-photon Avalanche Diode CMOS Image Sensors is ideal for an introduction to this exciting field as it starts from the basics, but at the same time, it is updated with references to the latest advanced works and digs deeper into their details. It is suitable for academic staff, researchers, Ph.D. students, and Master students of electronics engineering, but also for end users of SPAD-based image sensors who wish to gain a deeper understanding of the underlying technology.

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