辐射环境下 CMOS 图像传感器的暗电流幅值分布预测方法

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摘要： 在空间卫星系统中，CMOS 图像传感器也成为了首选的成像器件.然而，空间中存在的各种辐射粒子所引起的辐射效应，会使 CMOS 图像传感器暗电流均值增加、不一致性增强，导致图像信噪比降低，影响成像质量.基于半导体器件的辐射效应原理，分析了γ射线和质子辐射对 CMOS 图像传感器的总剂量和位移损伤效应，提出了一种混合辐射环境下暗电流分布建模方法.仿真结果表明，提出的方法能够准确预测γ射线和质子混合辐射环境下 CMOS 图像传感器的暗电流幅值分布情况.

关键词： 暗电流幅值分布；预测；质子；γ射线；辐射环境

Methods for Prediction Dark-Current Distribution of CMOS Image Sensor in Radiation Environment

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Abstract： Nowadays, CMOS image sensors are more and more used in a wide variety of applications, especially in satellite systems, where they are exposed to space radiation environment. In-orbit sensors suffer from radiation induced dark-current degradation that the dark-current mean value and non-uniformity increase, which results in the signal-to-noise-ratio decrease affecting the image quality. Based on the principle of radiation effects on semiconductor devices, this paper analyzes the ionizing and displacement damage effects in CMOS image sensors due to γ-rays and protons radiation, and proposes a method for dark-current distribution modeling in the mixed radiation environment. Simulation results proves that the proposed method is well adapted to predict the dark-current distributions for a device which is exposed to both rays and protons radiation at the same time.

Key words： dark-current amplitudes distribution； prediction; protons, γ-rays; radiation environment

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