

High Performance CMOS Range Imaging: Device Technology and Systems Considerations (Devices, Circuits, and Systems)

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This work is dedicated to CMOS based imaging with the emphasis on the noise modeling, characterization and optimization in order to contribute to the design of high performance imagers in general and range imagers in particular. CMOS is known to be superior to CCD due to its flexibility in terms of integration capabilities, but typically has to be enhanced to compete at parameters as for instance noise, dynamic range or spectral response. Temporal noise is an important topic, since it is one of the most crucial parameters that ultimately limits the performance and cannot be corrected. This work gathers the widespread theory on noise and extends the theory by a non-rigorous but potentially computing efficient algorithm to estimate noise in time sampled systems.

This work contributed to two generations of LDPD based ToF range image sensors and proposed a new approach to implement the MSI PM ToF principle. This was verified to yield a significantly faster charge transfer, better linearity, dark current and matching performance. A non-linear and time-variant model is provided that takes into account undesired phenomena such as finite charge transfer speed and a parasitic sensitivity to light when the shutters should remain OFF, to allow for investigations of largesignal characteristics, sensitivity and precision. It was demonstrated that the model converges to a standard photodetector model and properly resembles the measurements. Finally the impact of these undesired phenomena on the range measurement performance is demonstrated.



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