

## Thesis summary

Title: Current-assisted sensor devices for 3D Time-of-Flight Imaging

Student: Ward van der Tempel

Promoter: Prof. dr. ir. Maarten Kuijk

This dissertation presents a study on current-assisted sensor devices used for 3D Time-of-Flight Imaging.

Firstly, a complete model of a time-of-flight system is synthesized in order to better understand the requirements of each of the components in such a system. Based on this model, certain key parameters for the electro-optical mixing device are identified.

The current-assisted detection principle and the electro-optical demodulator devices based in this principle are analyzed in simulation. The general concept is turned into a practical implementation offering features such as low power consumption, pixelisation, low cross-talk, high responsivity of above 0.4 A/W for 870nm incident light, outstanding modulation contrast and bandwidth. These current-assisted photonic demodulator devices are in a subsequent step used to assemble an actual 3D Time-of-flight sensor. With a lateral resolution of 120x90 pixels, an intrinsic global shutter and high read-out speed, the sensor designed in this work targets indoor man-machine-interface type applications.

The 3-T type pixel structure was chosen as most performing topology and design challenges such as dynamic range optimization, read-out speed and linearity of the time-of-flight measurement are discussed.

The sensor device was then fabricated and characterized using a full-custom test-bench providing maximum flexibility in term of parametric analysis of the sensor devices. As most important parameters modulation contrast of 70% up to 25MHz modulation frequency are obtained.

The sensor devices designed in this work was finally implemented in a complete 3D camera system. System-level measurements confirmed both sensor characterization results and the Time-of-Flight model developed in this work. The system based in the designed sensor device is shown to have a distance resolution of below 1% using only 140mW optical power at real-time frame-rate of 25fps.