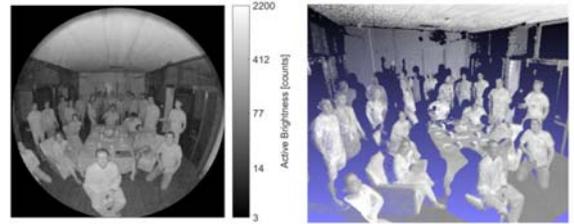




Microsoft Kinect (v2)



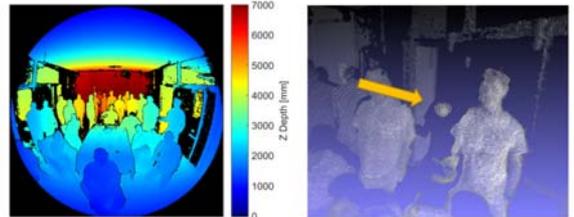
Lucid Helios ToF Camera



Microsoft Azure Kinect (2019)



pmdtec Selene Module



Amplitude and depth images delivered by the ToF sensor of a Microsoft Azure Kinect (left), together with general and detail views of the corresponding pointcloud (right).

Master Thesis

Performance Comparison of Novel 3D Cameras

In the last years we have been witness of an unprecedented development of one of the major techniques for 3-dimensional (3D) sensing, namely, Time-of-Flight (ToF) imaging. Differently from stereo cameras, ToF cameras do not rely on the scene texture to compute depth and are active systems, thus able to operate regardless of the illumination conditions. ToF cameras emit modulated light to the scene and then project the reflection onto an array of ToF pixels, acting as demodulators. Once the time shift between the emitted and received waveform is retrieved, the corresponding depth value can be immediately obtained, provided that the speed of light is a known constant.

Nowadays a worldwide-spread technology, the origins of ToF imaging are nonetheless rooted in Siegen, more specifically thanks to the groundbreaking research of Prof. Rudolf Schwarte in the late nineties on the so-called Photonic Mixer Device (PMD), a core technology for ToF pixels. Since then, the Center for Sensor Systems (ZESS) has been conducting uninterrupted research on ToF technology and applications, always in close cooperation with its spin-off pmdtec, which commercializes PMD-based ToF sensors.

The application range of ToF cameras goes from augmented reality (AR) and gaming to mobile robotics and autonomous driving, but, how good are the latest ToF cameras? What are the strengths and weaknesses of each one and how do they compare to one another?

Your Tasks:

- Review and eventually update our current knowledge on novel ToF cameras.
- Get an understanding of the key parameters that define the performance of ToF cameras.
- Get familiar with the experimental setups typically used to evaluate these parameters.
- Building upon our prior experience, design/update specific setups for a complete performance evaluation of ToF cameras.
- Perform a rigorous evaluation of the top-performing ToF cameras in the market.

Requirements:

- Studies of Computer Science, Mechatronics, or alike.
- Knowledge and broad experience in typical programming languages, minimally C++ and Matlab.
- Basic knowledge on 3D imaging and the ToF principle of operation.
- Self-discipline, ability to conduct independent work, and disposition to learn.