LumiCS -
Terahertz illumination concepts for reciprocal compressive imaging in silicon technologies

The project's main objective is to leverage silicon-based technologies for a breakthrough in terahertz (THz) compressive imaging. This interdisciplinary research project combines natural sciences with engineering sciences to realize a highly sensitive real-time THz imaging system without the need for mechanical scanning. The key innovation of LumiCS is an active Terahertz Digital Light Processor (T-DLP) fully integrated in a silicon process technology. Unlike simple THz point-sources, in a T-DLP the THz illumination is created by a matrix of digitally controlled source pixels. It combines the advantages of a reciprocal imaging system with novel compressed sensing (CS) algorithms, thereby enabling an imaging system where the number of THz sources and the number of THz image sensors (receivers) is much lower than the resolution of the captured image. Moreover, the number of patterns a T-DLP will need to create is significantly lower than the number of the obtained image pixels, thus reducing the overall image acquisition time compared with a reciprocal imaging system. The T-DLP and the image sensor chip will be implemented in a low-cost high-performance SiGe technology, providing a highly scalable, compact, and robust system solution. The research of LumiCS opens up a path towards practical implementation where CS-based algorithms, sampling, and digital signal processing are able to run simultaneously on a monolithically integrated circuit chip. Hence, it leverages the advantages of compressed sensing for the realization of future low-cost THz multi-pixel imaging system.

I Project Management and Execution

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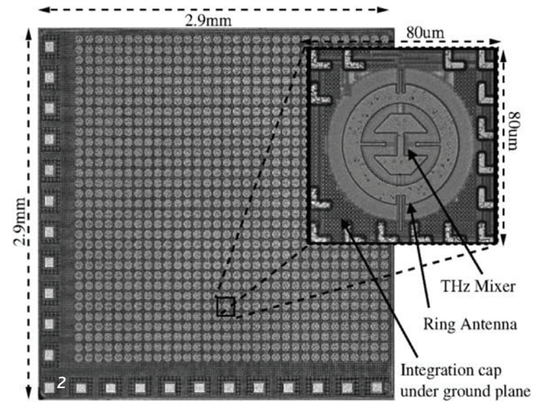
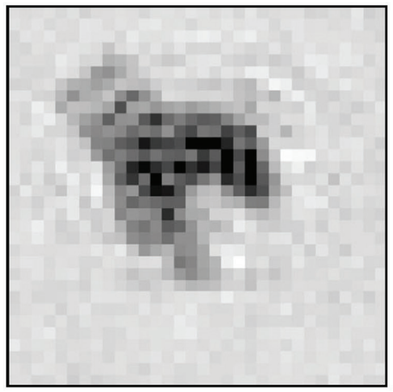


Figure 1:
THz CMOS camera chip housing

Figure 2:
micrograph of the 32×32 FPA (2.9 mm×2.9 mm) with a magnified view on a single detector (80 µm×80 µm)



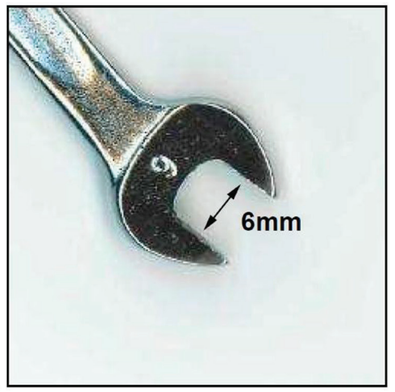


Figure 3:
a still frame from a metallic wrench [own 30]