



QUANTIC

The UK Quantum Technology Hub
in Quantum Enhanced Imaging

LOCKHEED MARTIN



TeraCAM™: Drone-mounted Terahertz Imager



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Terahertz (THz) imagers are invaluable tools for many applications, from defence and security to environment and agriculture. The combination of our THz imaging technology with an unmanned aerial vehicle will help to map water content in crops to increase yield.

The global market for THz systems is steadily growing, and it is projected to be worth USD 1.2 billion by 2024, up from USD 55 million in 2014. Current approaches to THz imaging suffer from major limitations, such as low scalability, bulky and expensive equipment, slow operation, and the need for cryogenic cooling. A technology offering compact, cheap, and room temperature imagers would greatly increase the impact of THz technology within society.

Researchers at QuantIC are developing TeraCAM™, an innovative, low-cost, and uncooled THz imager based on the use of metamaterial absorbers and microbolometer sensors. The uniqueness of TeraCAM™ is its full integration in a commercial CMOS process and its scalability to different wavelengths. The metamaterial is made directly in the metallic and insulating layers available in the CMOS process. The detected frequencies can be chosen by changing the geometry of the designed

metamaterial. Small prototype 5x5 pixel arrays have been fabricated and tested, and the technology is readily scalable.

Working with Lockheed Martin, QuantIC researchers are integrating TeraCAM™ with world-class unmanned aerial vehicles to map water content in a variety of crops (e.g. wheat and barley) using THz aerial imaging. The image captured will be overlaid with the visible one obtained by the CMOS sensors.

The ability to measure in-season grain quality will be a step change for the agricultural sector, which is valued at £620M in the UK. From a wider perspective, all cereal farmers (wheat, maize, soybeans, barley, oats and malt), would benefit from this technology, as they will readily be able to measure the drought stress that their crop is being subjected to, and therefore optimise growing conditions. Farmers will be able to maximise their yield

Application area	TeraCAM™
Estimated Component Cost	As laboratory demonstrator ≈ £5000 In volume < £500 (Quadcopter and source not included)
Present Performance Specs	Resolution: single pixel, 64 x 64 (under testing) Responsivity: 32.65 kV/W NEP: 108 pW/√Hz Thermal time constant: 68 ms
Latest Publications	J. Grant, et al. A monolithic resonant terahertz sensor element comprising a metamaterial absorber and micro-bolometer. Laser Photon. Rev. 7, 1043-1048 (2013) I. E. Carranza, et al. Metamaterial-based terahertz imaging. IEEE Trans. Terahertz Sci. Technol. 5, 892-901 (2015)

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