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Novel Real-Time Sub-Millimeter Imaging Device and Methods

The University of Memphis seeks a licensee to commercialize an exciting new imaging technology. Researchers at the University's College of Engineering have invented a portable device that can provide next-generation threat detection. The device is used with sub-millimeter waves that are able to penetrate man-made materials such as cloth. It can therefore improve the ability to detect hidden items such as guns and explosive devices and will do so at safe distances. The device also works in other frequency regimes from terahertz to ultraviolet. Additionally, the device works in real time and can generate images at video rates.

Applications

- Real-time sub-millimeter wave imaging detects threats hidden by cloth and others materials
- Dispersive terahertz spectroscopy can provide spectral analysis of hidden materials
- Imaging terahertz spectrometer is a combination device that can detect, localize and identify threats.
- Multi band imagers that provide optically registered images.
- Low cost imagers in frequencies ranging from terahertz to ultraviolet.

Advantages

- Smaller and lighter than other devices providing similar capabilities in the part of the spectrum where focal plane arrays are still costly and complex
- Real time video-rate imaging allows dynamic response capabilities by security personnel and solders
- Portability provides threat detection capability and remote locations and mobile platforms
- Single pixel imaging with very little mechanical complexity
- Very low production cost
- The wavelength independence of the device facilitates optically registered images for multimode imagers and spectroscopy applications

Technical Description

The invention consists of a spatially selective mask device for sub millimeter and higher frequency waves and of the methods used to sample and reconstruct the desired information from measurement made with the help of the device and a single pixel detector. The spatially selective mask is implemented using a spinning disk with many holes and an aperture that defines the scanning limits of the device. The dimensions and positions of the holes are carefully designed. Because the mask is implemented with a spinning disk it has very low mechanical complexity.

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The image scanning methodology makes possible the small physical dimensions of the device. The device also has very low production cost. The device facilitates real-time imaging in the sub millimeter wave regime as well as in other regimes. Video-rate imaging has not yet been demonstrated in the sub-millimeter wave regime with other methods. The holes on the disk impose only a higher limit on the wavelength that can be scanned and imaged; therefore, the device can be designed and used for multi-band imaging or spectroscopy applications. The device facilitates focal plane array like imaging with a single pixel detector.

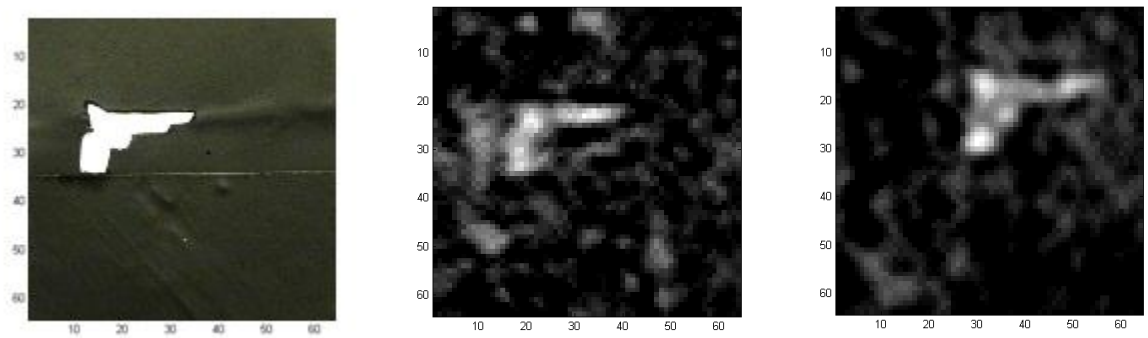

Figure 1: Left, aperture of a gun that was imaged to validate the proof of concept. Reconstructed 64x64 pixels sub-millimeter wave image (middle) and 64x64 pixel visible light image (right) scanned by the same disk at 50 frames per second.

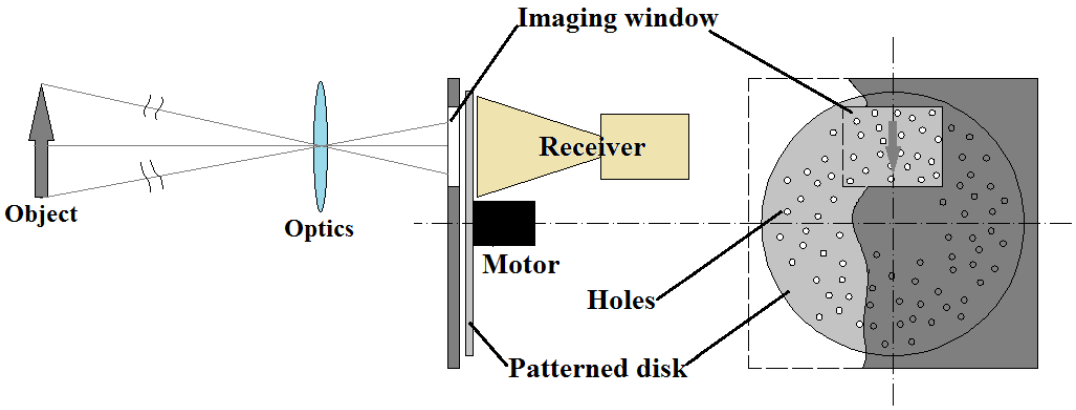

Figure 2: Conceptual sketch of the spatially selective mask device

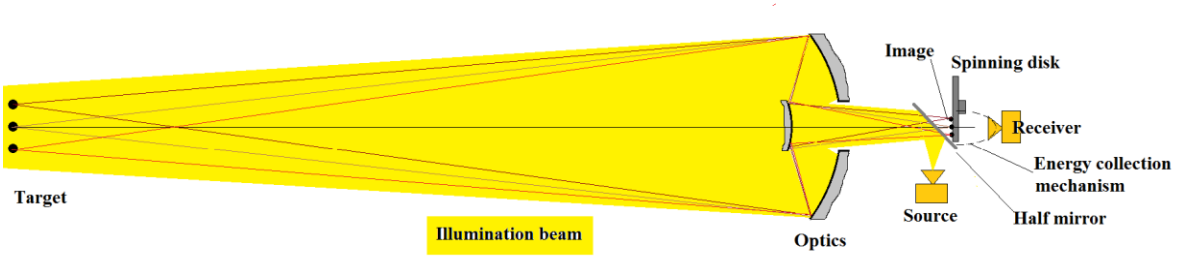

Figure 3: Possible stand-off imaging configuration

The Inventors

Orges Furxhi, Ph.D. is a post-doctoral fellow in the Department of Electrical and Computer Engineering at the University of Memphis. His Ph.D. was from the same department where he studied with Dr. Eddie Jacobs. This is his second patent pending invention.

Eddie Jacobs, Ph.D., is Assistant Professor and Interim Chair, Electrical and Computer Engineering Dr. Jacobs earned his BSEE and MSEE from the University of Arkansas. He earned his D.Sc. from George Washington University and joined the University of Memphis faculty in 2006.