Applications of superconducting bolometers in security imaging

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Millimeter-wave (MMW) imaging systems are currently undergoing deployment World-wide for airport security screening applications. Security screening through MMW imaging is facilitated by the relatively good transmission of these wavelengths through common clothing materials. Given the long wavelength of operation (frequencies between 20 GHz to $\sim$ 100 GHz, corresponding to wavelengths between 1.5 cm and 3 mm), existing systems are suited for close-range imaging only due to substantial diffraction effects associated with practical aperture diameters. The present and arising security challenges call for systems that are capable of imaging concealed threat items at stand-off ranges beyond 5 meters at near video frame rates, requiring substantial increase in operating frequency in order to achieve useful spatial resolution. The construction of such imaging systems operating at several hundred GHz has been hindered by the lack of submm-wave low-noise amplifiers. In this paper we summarize our efforts in developing a submm-wave video camera which utilizes cryogenic antenna-coupled microbolometers as detectors. Whilst superconducting detectors impose the use of a cryogenic system, we argue that the resulting back-end complexity increase is a favorable trade-off compared to complex and expensive room temperature submm-wave LNAs both in performance and system cost.

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