Passive Polarization-Sensitive Outdoor MMW Imaging

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Quasi-optical systems operating at millimeter wave and terahertz radiation spectral ranges due to penetrative properties of the radiation are able to provide essential information on observable objects when visual and infrared imaging systems are not effective [1-2]. Both passive and active MMW/THz imaging systems have demonstrated their ability to detect objects beneath individual clothes in surveillance indoor applications. Thereby passive systems are essentially effective for imaging outdoor scenes [3] which exhibit enough brightness temperature contrast for system operation.

Fig.1

In this paper possibilities of polarization-sensitive passive quasioptical imaging of complicated outdoor scenes under various environmental condition are experimentally investigated. For the goal a multifunctional experimental imaging system has been developed (Fig.1). In the system a polysterene lens with diameter 60 cm and focal length 1 m is used as a focusing lens. Mechanically scanning precise positioner being under computer control provides oversampled imaging with factor 16x for 94 GHz radiation. Radiometer receiver is microprocessor-controllable unit with stabilization of internal temperature for providing stable long–time action. Its operating frequency is 94 GHz, temperature sensitivity is less then 0.1 K /s. Sample time per pixel is changeable by computer program (from 0.1 s to 5 s and more). The input horn antenna of the receiver is supplied with polarization grid exhibiting cross-polarized component transmisivity less then 10^{-2}. (Radiometric receivers for 140 GHz and 220 GHz are currently under development). The system is provided with computer controllable mechanical unit for rotating the receiver around the optical axes with accuracy 0.5^0 for polarization imaging and shifting one along the optical axes with accuracy 0.5 mm for sharp focusing. Imaging system possibilities have allowed to reveal peculiarities of MMW polarization imaging. Particularly it was shown that metallic-like objects may be better detected within terrain by means of analysis of its polarization-distinct images (or images consisting of coherence matrix elements).

References.

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