VIDEO ARTICLE

Vid. Proc. Adv. Mater., Volume 2, Article ID 2110239 **(2021)**

Dispersion-Enhanced Plasmonic Metamaterial for Single-Shot Microwave Imaging

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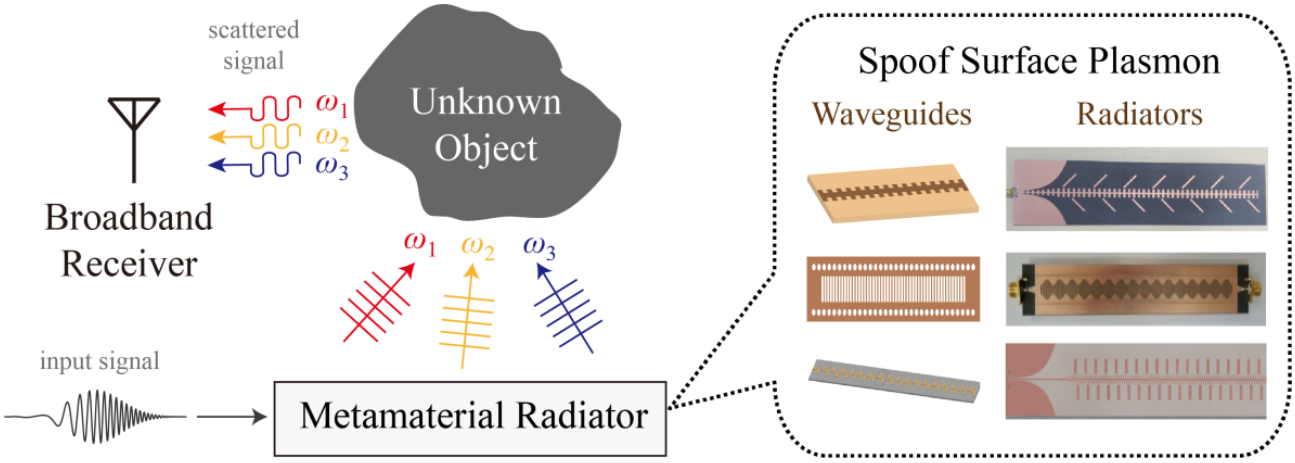
DOI: 10.5185/vpoam.2021.10239

Graphical Abstract



Abstract

Frequency-diverse microwave imaging provides a new way to capture spatial information in a single shot using the frequency degree of freedom, which is very useful in capturing rapidly moving or vibrating objects. The figure above illustrates the working principle of frequency-diverse microwave imaging. As a broadband signal enters the metamaterial radiator, different frequencies excite beam radiations at different directions to shine the unknown object, and the scattered signals are collected by a broadband receiver. These different beams representing various independent measurements for the unknown objects. As long as the measurement number is sufficiently large, the unknown object can be recovered from its scattering waves. Since the metamaterial is able to offer a set of beams radiating into different directions in a single shot, it features a higher speed in data acquisition in comparison with the conventional approaches using mechanical scanning or electronic switching. High dispersion is highly preferred in the design of metamaterial for frequency-diverse microwave imaging because it is able to collect the spatial information using a narrow-spectrum signal, which, not only save the spectrum resources, but also relax the bandwidth requirement of A/D converter in the base-band hardware. Spoof surface plasmon (SSP) is an artificial metamaterial that supports a surface wave propagating along the interface between SSP and surrounding medium. This surface

wave features extremely high dispersion as it operates close to the surface plasmon frequency. This talk will systematically introduce the design of dispersion-enhanced SSP structures at microwave frequencies for wave guiding and radiating. SSP waveguides cover two novel hybrid structures for dispersion enhancement, including substrate integrated waveguide SSP and half mode substrate integrated waveguide SSP configurations. Periodically modulating the profile of SSP waveguides or periodically loading the SSP waveguides lead to leaky wave radiations. Both of these two techniques are introduced for the design of SSP radiators. This talk will also present several frequency-diverse microwave imaging examples using SSP waveguides and SSP radiators. Frequency-diverse imaging will find wide applications in automotive radar, biomedical sensing, and security screening, etc.

Keywords: Dispersion; microwave imaging; Spoof Surface Plasmon (SSP).

Citation of Video Article

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