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Accession number:20113314231051

Title:Mastering the propagation through stacked perforated plates: Subwavelength holes vs. propagating holes

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Source title:IEEE Transactions on Antennas and Propagation

Abbreviated source title:IEEE Trans Antennas Propag

Volume:59

Issue:8

Issue date:August 2011

Publication year:2011

Pages:2980-2988

Article number:5871297

Language:English

ISSN:0018926X

CODEN:IETPAK

Document type:Journal article (JA)

Publisher:Institute of Electrical and Electronics Engineers Inc., 445 Hoes Lane / P.O. Box 1331, Piscataway, NJ 08855-1331, United States

Abstract:More insight on the physics underlying the transmission through subwavelength hole arrays prism by comparing it with propagating hole arrays prism is provided. We show the critical role that the size of the holes plays in this electromagnetic propagation, changing the effective index of refraction from negative (backward wave) to positive values (forward wave) as the hole diameter increases. This causes negative refraction for the zeroth order emerging beam in the cut-off holes prism whereas positive refraction in the non-cut-off holes prism. Furthermore, we revisited from the perspective of superposition principle the explanation of these stacks based on the so-called building sub-units: horizontal rods and vertical wires. Our simple analysis reveals the drawbacks of this earlier interpretation, and reinforces the powerful model founded on a inverse transmission line. Experimental results (co-and cross-polar measurements) performed at the V-band of the millimeter-waves in the Fresnel zone are well supported by numerical analyses. As expected, higher order diffracted outgoing beams are recorded for the classical prism but not for the cut-off holes prism. © 2011 IEEE.