Surajit Kundu, J Sens Netw Data Commun 2021, Volume 10

Radiation improvement of ultra-wideband antenna using frequency selective surface for impulse radar applications

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Statement of the Problem: Impulse Radar such as Ground Penetrating Radar (GPR) is commonly used as EM scanner to produce the pseudo images of buried objects. Depth and lateral resolutions of such scanning techniques can be improved by enhancing the working bandwidth. Planar antennas in the commercial Ultra-wideband (UWB) are potential candidate to improve the resolutions due to the wide spectrum coverage from 3.1 to 10.6 GHz. However the soil attenuation increases with increase in frequency which restricts the depth of coverage. One unique way to solve this issue is addressed here by integrating UWB frequency selective surface (FSS) to the antenna for gain augmentation.

Methodology & Theoretical Orientation: Antenna radiation can be enhanced in various ways such as array configuration using metallic reflector but these methods are not suitable for UWB. Metamaterial inspired periodic electromagnetic band gap materials can act as partial reflective surface when integrated below the antenna and enhance the antenna radiation in the broadside direction by reflecting the antenna s back radiation. Due to the linearly decreasing reflection phase response of reflective surface the reflected waves become co phased with the transmitted wave in broadside direction and added constructively to improve the radiation and thus gain augmentation in the entire UWB without degrading other antenna parameters. The high gain UWB Antenna-FSS composite structure can be very effective for sub surface scanning applications.

Findings: Uniplanar and dual layered FSS structures are designed and integrated to the ultra and super wideband antennas. The characteristics of antenna with and without FSS are studied by simulation and experimental measurements where good correlation between the simulated and measured data validates the performance. The transient and frequency domain analysis of Antenna-FSS integrated structure is carried out in vicinity of different surfaces such as dry soil wet soil wood etc. where the fitness of proposed structure for GPR application is attained.

Conclusion & Significance: The conventional impulse radar antennas have certain limitations that can be improved by incorporating UWB antenna-FSS. The detailed study and comparative analysis with other reported work ensure the applicability of this solution.

Biography

Surajit Kundu received his B.Tech degree in ECE from Academy of Technology West Bengal University of Technology India in 2009 M.Tech degree from Indian Institute of Technology Kharagpur in 2012 and Ph. D. degree from National Institute of Technology Sikkim India in 2018. He has served the department of ECE SKFGI as assistant professor in 2012 and worked in UIT the University of Burdwan in 2013 as Assistant Professor. Presently he is serving as assistant professor in the Department of ECE NIT Sikkim. He has published 38 research papers in referred journals and conference proceedings of repute. His research interest includes antenna design ultra-wideband communication EBG materials metasurfaces satellite communication & navigation and ground penetrating radar. He received "Young Indian Radio Scientist" Award from URSI-InRaSS in AP-RASC 2019. Surajit Kundu is a senior member of IEEE and URSI since 2020.