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Maximizing Bandwidth-to-Thickness Ratio of Electrically Thin Absorbers through Dispersion Engineering

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In this presentation, we will discuss the latest results on our recently developed concept, which enables absorbing surfaces to achieve a bandwidth-to-thickness ratio approaching Rozanov's ultimate limit [1]. Absorbers designed with this concept utilize a carefully engineered, passive non-Foster impedance grid positioned at a defined distance from a ground plane. The non-Foster impedance grid is implemented in a fully passive platform through dispersion engineering. Our findings show that absorbers based on this concept, which integrate a specified order of dispersion within the impedance grid, achieve a bandwidth-to-thickness ratio that exceeds Rozanov's established bounds for metal-backed dielectric absorbers of equivalent thickness and dispersion order. Additionally, the integration of fourth-order Lorentz dispersion within the impedance grid yields a substantial enhancement, enabling our design to surpass Rozanov's established limit for metal-backed dielectric absorbers with an infinite order of dispersion within the dielectric. Remarkably, absorbers utilizing our proposed dispersive grid with a single order of Lorentz dispersion achieve very high absorption bandwidth-to-thickness ratio, surpassing previously established upper bounds on the bandwidth-to-thickness ratio of absorbers using advanced engineered surfaces including those using dispersionless metamaterial screens [2] and Foster high-impedance surfaces [3].
We subsequently established an ultimate limit on the bandwidth-to-thickness ratio for dispersive, grid-based, metal-backed linear time-invariant absorbing slabs, reaching 95.5% of Rozanov's theoretical bound. Finally, as a proof of concept, we applied this approach to design, fabricate, and experimentally validate an absorber, achieving very high absorption bandwidth-to-thickness ratio.

References

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