Rapid Prototyping of Low-Profile Dielectric Beam Steering Device Using Additive Manufacturing

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This work explores the use of additive manufacturing techniques in the fabrication of low-profile beam steering devices. Traditional mechanical beam steering structures are high-profile solutions not suitable for mounting on vehicle platforms. Electronically steered phased array systems offer a low profile, but are prohibitively expensive limiting their application almost exclusively to government projects. Risley prisms offer a possible solution to the profile of mechanical structures, but retain significant bulk in order to achieve high steer angles. Recent work has utilized stepped dielectric lenses to provide mechanical beam steering while reducing the profile in comparison to a classic Risley prism (N.A. Stutzke, et. al, "Low-profile method and apparatus for mechanical steering of aperture antennas," U.S. Patent 8 068 053, November 29, 2011).

Proposed is the use of 3D-printed variable density dielectric sections over an aperture, in lieu of steps. We implement a gradient in the dielectric constant by adjusting the density of the infill structure in each section resulting in a cumulative phase shift on the main beam. The use of additive manufacturing with high-dielectric ABS plastic filament is a further improvement on the cost effectiveness and ease of manufacture over previous work. Simulated beam steering performance will be presented as well as an outline for using the prism in a mechanically steered direction finding radar at 5.85GHz.