



Goal

Fabricate complex 3D geometries in which the electrical properties (e.g. dielectric constant) vary nearly arbitrarily in three dimensions





3D Printed Graded Dielectrics



Use of Space Filling Curves







Example Applications: Luneburg Lens

3D Luneburg Lens Beamformer







Example Applications: Luneburg Lens





Additive Manufacturing of Multifunctional RF Devices and Systems



Example Applications: Luneburg Lens

Fabricated Luneburg Lens using 3D Printing





Additive Manufacturing of Multifunctional RF Devices and Systems



W-Band Luneburg Lens (70-110 GHz)

Fabricated W-band Luneburg Lens using FDM printing with a 50 μm



Z. Larimore, S. Jensen, A. Good, J. Suarez and M.S. Mirotznik, "Additive Manufacturing of Luneburg Lens Antennas Using Space-Filling Curves and Fused Filament Fabrication", under review IEEE Transactions on Antennas and Propagation, August 2017.



Additive Manufacturing of Multifunctional RF Devices and Systems



W-Band Luneburg Lens (70-110 GHz)











Example Applications: Luneburg Lens







Additive Manufacturing of Multifunctional RF Devices and Systems



Example Applications: Luneburg Lens

- No boresight drift at different measured frequencies
- Supports -30°→+30° field of view with negligible performance reduction
- Can support larger FOV with reduced performance







Modified Luneburg Lens

Quasi-Conformal Transformation Optics





Additive Manufacturing of Multifunctional RF Devices and Systems



Modified Luneburg Lens

Quasi-Conformal Transformation Optics







Modified Luneburg Lens

Quasi-Conformal Transformation Optics

Fabricated Luneburg Lens using FDM Printing



Made from polycarbonate (ϵ_r =2.7)







Modified Luneburg Lens







Modified Luneburg Lens







Modified Luneburg Lens with integrated Antireflective Coating







Modified Luneburg Lens with integrated Antireflective Coating





UNCLASSIFIED









Modified Luneburg Lens with integrated Antireflective Coating

Higher permittivity lens for very wide angle scanning







Luneburg Lens based Direction of Arrival Sensor







3D Luneburg Lens Passive Imager

- Good return loss across Ka-band and part of K-band (<-10 dB)
- Linearly polarized
- Balun to create balanced antenna



Simulated current density









Luneburg Lens based Direction of Arrival Sensor



Complete System



Antenna Matrix

October 16th , 2019



Backside Showing LED Indicators and Battery



Side View of Power/Digital Board and Antenna Matrix

UNCLASSIFIED



UNCLASSIFIED