Department of the Navy SBIR/STTR Transition Program

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Topic # N231-063
Advanced Hybrid Gradient Index Lenses via Additive Manufacturing of Low-Loss Materials
3DFortify Inc.

WHO

SYSCOM: ONR

Sponsoring Program: ONR Code 312 - Electronic Warfare

Transition Target: Switched Beam Antennas, pod-mounted EW for class 3/4/5 UAV (Vanilla, Reaper, Predator), 5G Comms (Army PEO C5ISR)

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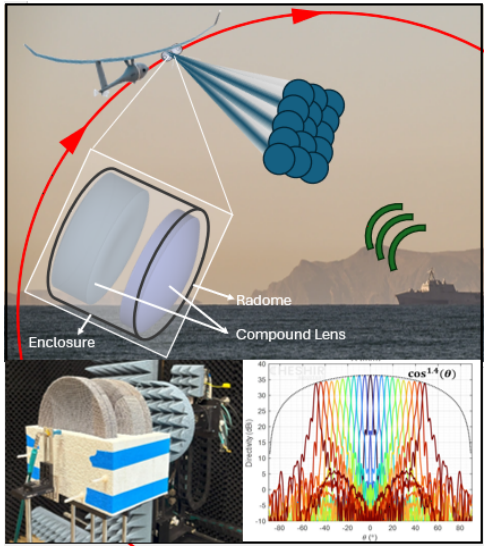
Other Transition Opportunities: Ultra broadband, hybrid GRIN lensing has applicability across many comms, EW, and RADAR surface/air platforms to improve SWaP-C and bandwidth for beam steering systems requiring DF/ELINT functionality, LPD/LPI, or improved antenna gain/field of view.

Notes: Fortify's hybrid GRIN lenses are manufactured from tailored gradient index 3D printed materials - enabling ultra broadband performance via passive true time-delay in the lens. The graphic shows one compelling embodiment - a UAV pod-mounted ELINT system using a switched beam lens antenna. Final deliverable will have a compound lens architecture mounted within an enclosure and radome, shown by the diagram in the graphic.



Photos courtesy of University of Notre Dame and Cheshir Industries. Other images sourced from public use DoD websites.

WHAT

Operational Need and Improvement: DoN requires capabilities to design and produce GRIN lenses that leverage high dielectric constant, low loss, 3D-printable materials for microwave/mm-wave lensing and antenna structures that can operate over large bandwidths and challenging environmental conditions.

Specifications Required: GRIN lens structures suitable for UAV mounting that cover at least 10-to-1 bandwidth (objective 2-40 GHz), scan loss exponent of less than 2.5, peak sidelobes no more than 20-dB down from peak gain when steered at boresight, and no more than 15 dB when scanned to 50 deg off boresight. Other objectives: minimize lens weight, minimize dielectric and other efficiency losses, reduce overall lens thickness, minimize production costs, and minimize performance or material impacts that arise in naval conditions.

Technology Developed: Fortify and partners have developed/matured RF lens design and manufacturing workflows for Gradient Index lensing. Fortify demonstrated this capability via development of 3D printed dielectric steerable Gradient Refractive Index (GRIN) lens for Switched Beam Array (SBA) antennas that has extreme 13-to-1 instantaneous bandwidth (3 to 40 GHz), excellent scan loss to 50° (~1.4), with an aperture efficiency nearing 40%, manufactured from 3D printed materials ranging in Dk from 1.35 to 5.0.

Warfighter Value: Hybrid GRIN lenses and the associated design/manufacturing workflows offer the warfighter access to lower SWaP-C, ultra broadband beam-steering antenna capability for low cost, attritable, UAV and other platforms for RADAR, EW, and COMMs applications. When paired with a switched beam antenna array, hybrid GRIN lenses offer cheaper, lighter, lower power, low scan-loss beam-steering alternative to costly and power-hungry phased arrays.

WHEN

Contract Number: N68335-24-C-0292 **Ending on:** Aug 31, 2025

Milestone	Risk Level	Measure of Success	Ending TRL	Date
Feasibility of hybrid material GRIN lensing	Low	Beam forming and steering up to 20 GHz	3	1st QTR FY24
Single lens scanning performance	Low	Measurement result show scan loss < 4	4	3rd QTR FY25
3-40 GHz Bandwidth Performance	Medium	Radiation efficiency/gain remains strong up to 40 GHz	4	3rd QTR FY25
Compound lensing	Medium	Scan loss exponent < 2	4	3rd QTR FY25
Integration into protective enclosure with radome	Low	No significant reduction in RF performance	4	4th QTR FY25
Environmental testing	Medium	Equivalent performance before and after exposure to relevant environmental conditions	5	1st QTR FY26
Hybrid lens integrated with wideband antenna system	Medium	Meets antenna system requriements	6	1st QTR FY26

HOW

Projected Business Model: The lens technology requires integration into an antenna system for it to solve a problem for the Navy or other services. The first demonstration of this will in a separate Army C5ISR center funded program for 5G Command and Control systems, with delivery and testing expected EOY 2025. Future applications will require development and integration efforts to take this lens technology into an antenna prototype to solve a Naval challenge. Fortify will collaborate with system integrators like RTX, LMCO and/or antenna system companies like ARA to develop a complete antenna system for a future naval capability. Long term, Fortify will be the the design and manufacturing partner for lenses and lens antennas.

Company Objectives: Fortify's objective is to transition this lens technology and adjacent RF lens/dielectric/antenna structures into a programs of record to solve challenges for the warfighter within the Navy or other services.

Potential Commercial Applications: 5G mm-wave antennas, 5G densification antennas, commercial airline SATCOM, SATCOM ground terminals, rail trackside backhaul, commercial RADAR (security, monitoring)

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