Department of the Navy SBIR/STTR Transition Program

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ONR Approval #2025-8-27-1329

Topic # N231-063
Additive Manufactured Low-Loss Small-Size Low-Profile Conformal GRIN Lens in the K-Band
Agile RF Systems LLC

WHO

SYSCOM: ONR

Sponsoring Program: ONR SBIR

Transition Target: Air Platforms; Ground/Sea Platforms

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Other Transition Opportunities: Telecom infrastructure, satellite communciations, automotive radar, 5G/6G base stations and research

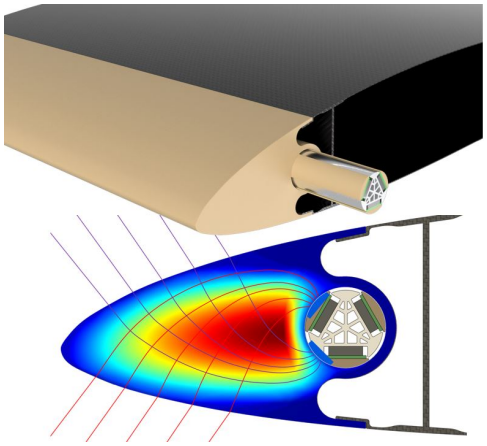

Image courtesy of Agile RF Systems, LLC

Notes: Freeform Gradient Index (F-GRIN) lenses in microwave and mm-wave applications could provide lower cost beam steering options for high power radar, SAR, communications, and EW implementations in small and envelope-constrained platforms, without the cost, complexity, and aperture geometry constraints of phased array implementations. Agile RF Systems has demonstrated an F-GRIN additive manufacturing method capable of dielectric constants as high as 20 using polymer materials with some of the highest available thermal, mechanical, and dielectric loss properties for microwave and mm-wave applications. A new class of lensing apertures for simple point feed or line array emitters - lens systems that are compact, conformal, and even structurally integral to the platform - are being explored.

WHAT

Operational Need and Improvement: The Navy seeks conformal gradient-index (GRIN) lens structures for integration onto curved surfaces like the fuselage of small Group 2 unmanned aerial systems (UAS). These lenses must deliver wideband, high-efficiency beam steering while minimizing weight, thickness, and thermal/electromagnetic losses. This effort aims to improve sensor and antenna integration on compact platforms by enabling lightweight, broadband, power-tolerant lenses that maintain performance across wide scan angles and harsh maritime conditions.

Specifications Required: The lens must be capable of operating across a broad 10:1 bandwidth, ideally spanning 2 to 40 GHz, while conforming to curved surfaces like a small UAS fuselage. The design must maintain high beam steering performance, with a scan loss exponent below 2.5 and sidelobe levels at least 20 dB below peak gain at boresight and 15 dB at 50° scan. Additional requirements include minimal weight and thickness, low dielectric and efficiency losses, thermal resilience up to 10 kW microwave power, cost-effective manufacturability, and suitability for naval maritime environments.

Technology Developed: Agile RF Systems' freeform gradient index (F-GRIN) microwave and mm-wave lens design and manufacturing workflow is capable of producing lenses with novel RF loss performance, steering performance, thermal-structural performance, and true mm-wave capability, while virtually eliminating the design constraints imposed by legacy subtractive and additive GRIN & F-GRIN lens manufacturing processes. This new F-GRIN lens production method is uniquely suited to weight sensitive applications with constrained envelopes, and applications where a structurally and/or functionally integral lens antenna system is advantageous.

Warfighter Value: These novel lens structures and lens antenna systems can enable greater sensing, detection, communication, & response capabilities for smaller platforms at a lower cost than alternative beamforming methods. The desired impact is a greater number of more capable and less expensive systems contributing to enhanced warfighter situational awareness and control throughout the electromagnetic operational environment.

WHEN

Contract Number: N68335-24-C-0287 **Ending on:** Aug 31, 2026

Milestone	Risk Level	Measure of Success	Ending TRL	Date
F-GRIN Manufacturing Methods Review	N/A	Comprehensive review of the state-of-the-art, shortcomings & research lacuna	1	2nd QTR FY24
Novel Manufacturing Method Demonstrated	High	Lab-scale manufacturing method developed, expected properties achieved	4	4th QTR FY24
Design Synthesis, Software, Hardware Strategies for Higher TRL	Low	Downselections complete	4	1st QTR FY25
Lens Material Properties Validated thru W Band	Medium	Materials produced via novel method shown functionally isotropic, non-scattering	4	2nd QTR FY25
Manufacturing Software Demo	Low	Basic functions of manufacturing software (custom CAM) demonstrated	5	4th QTR FY25
Manufacturing Hardware Demonstration	Medium	Basic functions of higher TRL manufacturing system demonstrated	5	1st QTR FY26
All-up F-GRIN Manufacturing Workflow Demo	Medium	End-to-end functionality of design synthesis, mfg. software, mfg. hardware, testing & validation	6	2nd QTR FY26

HOW

Projected Business Model: Agile RF Systems is seeking primarily to facilitate design for manufacture (DFM) and manufacturing of F-GRIN lenses with novel capabilities via the manufacturing method being developed. This approach allows for the focused refinement of the manufacturing method and adjacent technologies, to serve an emerging market which is becoming saturated with interest and lens antenna system concepts, but is markedly deficient in adequate manufacturing capability to serve this interest.

Company Objectives: Agile RF Systems aims to enable a new class of flexible, practical, affordable directional antenna systems with this technology. Agile's expertise in high performance, low-cost phased array antenna system implementation suggest several commercial and defense applications which could be simplified and made more capable through the application of high performance lensing, including envelope-constrained EW, SAR, atmospheric sensing, and wideband communications.

Potential Commercial Applications: Wideband, high steering capability lens antenna systems, including hybrid electronic/mechanical steering systems, could enable:
- High performance/low cost SATCOM terminals, replacing phased array or gimbaled dish systems
- Increased 5G/6G base station performance, reduced envelope & power consumption
- Security & surveillance radar systems with reduced reliance on moving parts or large antenna arrays
- Smaller sensor footprints for autonomous vehicles and other obstacle avoidance radar-equipped systems

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