

REQUEST FOR INFORMATION (RFI)

ONR RFI Announcement #

Title: Panoramic Imaging for Situational Awareness and Target Recognition

N00014-17-RFI-0005

I. DISCLAIMER:

This announcement constitutes a Request for Information (RFI) for the purpose of determining market capability of sources or obtaining information. It does not constitute a Request for Proposals (RFP), a Request for Quote (RFQ) or an indication that the Government will contract for any of the items and/or services discussed in this notice. Any formal solicitation that may subsequently be issued will be announced separately through Federal Business Opportunities (FedBizOpps). It is the responsibility of any potential contractor to monitor Federal Business Opportunities (FedBizOpps) for additional information pertaining to this topic.

Information on the specific topic of interest is provided in the following sections of this announcement. Neither ONR nor any other part of the federal government will be responsible for any cost incurred by responders in furnishing this information.

II. BACKGROUND:

The Office of Naval Research (ONR) C4ISR Department (Code 31), Image Sensing and Processing (ImSP) Program objective is to detect, classify/identify, and localize/geolocate air, sea-surface, and ground targets. The primary interest is for systems working in visible and infrared (near, short wave, mid wave and long wave) regions of the electromagnetic spectrum. However, passive millimeter wave region is also of interest due to its superior atmospheric transmission properties in degraded visual environment (clouds, dust, fog, rain). Long range imaging through such environments is a thrust within this program. Both active (where source of illumination is under user control) and passive (using ambient illumination) ImSP systems operating in visible and infrared spectral bands are of interest. Exploiting multiple modalities associated with electromagnetic waves (spectral, polarimetric, temporal and quantum signatures) in addition to conventional spatial imaging is expected to provide additional information about the targets and hence improve performance under challenging environmental conditions. ONR ImSP program is also interested in exploring systems that do not form images in a traditional sense and yet are able to achieve the primary objectives through unconventional measurements augmented by sophisticated inverse processing operations. ONR ImSP is interested in supporting basic and applied research that advances state of the art in these broad areas.

III. SPECIFIC INFORMATION OF INTEREST:

The US Fleet Forces often operate in congested waterways throughout the world for a variety of humanitarian and military purposes. To maintain situational awareness (SA) and to support target detection, tracking, recognition, identification and determination of hostile intent, electro-optical (EO) and infrared (IR) sensor systems are necessary. In contrast to radar, EO/IR sensor systems have superior resolution, form images, and can operate in the absence of active emissions. Surface ships require self-protection against a diversity of threats, surface and air borne. The primary spectral band used by Navy has been passive Mid Wave Infrared (MWIR) to allow day-night operation. Short Wave Infrared (SWIR)

has also been discussed to enable improved haze penetration while providing better resolution than MWIR and reflective (as against emissive with MWIR) phenomenology. As such it is important to monitor with high angular resolution, and video frame rate, the entire hemispherical dome, 360 degrees azimuth X 110 degree vertical (ranging from -20 degree below the horizon to 90 degrees above - zenith) for potential threats with imaging systems. In most operational scenarios a large fraction of pixels will not contain meaningful or relevant information and hence a brute force approach is deemed to be extremely inefficient in terms of resource (size, weight, power, communication bandwidth and cost) utilization. It should also be noted that as the vertical angle changes from below the horizon (close to the ship) to directly overhead, the nature of the background and expected threat signatures will also change in a dramatic manner. Therefore it may not be appropriate to employ an imaging sensor with operational characteristics that remain invariant over a wide range of vertical angles. For the purpose of this RFI we will focus on systems with a FOV restricted to 360 degree azimuth and 50 degree elevation coverage (nominally -20 to +30 degrees about the horizon) and not the full hemispherical coverage described above.

This problem is currently addressed by using two distinct architectural options:

- A. Use medium resolution (~ 80 microradian) instantaneous Field of View (iFOV) imaging sensor with desired (50 degrees) elevation Field of View (FOV) and scanning it continuously to provide 360 degree coverage in the azimuth direction.
- B. Use coarse resolution (100-200 microradian iFOV) staring imaging sensor arrays with desired azimuth and elevation FOV to provide required coverage at video rate in order to perform detection and coarse tracking of potential objects. Cues generated by such a system are then used to steer a narrow field of view, high resolution (10-30 microradian iFOV) and video frame rate imaging sensor to provide recognition, identification, fine tracking and hostile intent determination capabilities.

Each of these solutions has drawbacks. Option A reduces the revisit rate for a specific target to typically a few Hz thereby missing fast moving targets. It can also lead to false alarms in heavy clutter background. Finally a continuously scanning system will have lifetime issues due to mechanical breakdowns. Option B maintains situational awareness at frame rates fast enough to track moving targets and is better able to handle clutter to reduce false alarm rates for detection. But in the presence of multiple contacts (10's to 100's) the narrow field of view sensor will have poor revisit rate. It will also have latency issues as the high resolution imager is slewed from one contact to another. Finally the same issues about lifetime due to mechanical wear and tear that affect Option A will also affect Option B.

The ONR Code 312 EO-IR Technologies Focus Area seeks information on unconventional approaches to tackling this problem by providing alternatives to Options A and B discussed above. An ideal system will provide a coarse resolution staring mode for situational awareness over the panoramic field of view, while simultaneously under software control providing multiple (>100) regions over which high resolution and video frame rate images are obtained. These regions can also be dynamically steered without mechanical motion to follow the object of interest. By providing higher resolution only over regions of interest, such a system will minimize the data transfer bandwidth as well as size, weight, power consumption and cost of the overall system.

It is recognized that fundamental laws of physics will constrain the system designs that are possible and will also force inherent tradeoffs between resolution, field of view, frame rate, and integration time (affecting sensitivity) for a given level of SWaP-C-Bandwidth resources. ONR is interested in fully

exploring and characterizing the design philosophy that will lead to expanded trade space. It should be emphasized that various classes of ships (a patrol craft, a frigate, a destroyer and a carrier) has widely different performance requirements as well as level of available resources. So another objective of this RFI is to identify a family of imaging systems that result from an overarching design philosophy. Finally ONR does not impose any *a priori* restriction or a dogmatic position (such as no mechanical motion allowed within a system) based on abstract consideration but aim to take a pragmatic approach to addressing this problem. ONR is seeking inputs that are grounded in sound physical principles, are consistent with roadmaps for relevant technologies (optics, focal plane arrays, and image processing hardware/algorithms), exploit latest innovative concepts, and are responsive to Navy's operational needs and environment.

IV. SUBMISSION INSTRUCTIONS and FORMATTING REQUIREMENTS

- a. Responses are requested no later than **6 October 2017 at 4:00 PM Washington, D.C. Time**. Any response received after this date will also be considered but may not be included in initial reporting or assessments.
- b. All responses should be in PDF format and emailed to the technical point of contact: **Ravi Athale (ravindra.athale@navy.mil)**. The subject line of the email should read as follows "Panoramic Imaging for Situational Awareness".
- c. All responses shall be unclassified. No classified responses will be accepted under this RFI. If proprietary information is submitted, it must be portion marked at the paragraph level to indicate those specific paragraphs that contain proprietary information. All information received in response to this RFI that is marked proprietary will be handled accordingly. Responses to this notice will not be returned.
- d. Required content and submission organization:
 1. Cover Sheet – RFI number, company name and address, technical point of contact, printed name, title and email address and date.
 2. Technical description of the proposed concept or capability, including a concise description of the underlying principles, a realistic assessment of limits of performance, and a comparison to existing capabilities. Technical challenges, risks, and risk mitigation strategies should be outlined. Experimental and/or theoretical evidence to validate/support the technical solution should be provided. This section should not exceed 5 pages, single-spaced, 12 point font, including charts, graphs, or other illustrations.
 3. Relevant past experience. No more than one-page description of past relevant experience should be included.
 4. Response may include non-binding Rough Order of Magnitude (ROM) cost estimates that will be considered only for planning purpose.
 5. Small Business Concerns, Historically Underutilized Business Zone (HUBZone)

Concerns, Service-Disabled Veteran-Owned Small Business (SDVOSB) Concerns, Small Disadvantaged Business (SDB) Concerns, Women-Owned Small Business (WOSB) Concerns and Veteran-Owned Small Business (VOSB) Concerns are all highly encouraged to respond to this RFI.

V. QUESTIONS AND POINT OF CONTACT

Questions of a technical nature regarding this RFI may be sent to the following Technical Point of Contact:

Name: Ravi Athale
Title: Program Officer
Office of Naval Research
Division Code: 31
Address: 875 N. Randolph St, Arlington, VA 22203
Email Address: ravindra.athale@navy.mil

Questions of a business nature regarding this RFI may be sent to the following Business Point of Contact:

Name: AnShawn Lewis
ONR Code BD 0252
Office of Naval Research
875 North Randolph Street, Suite W1267B
Arlington, VA 22203-1995
Email: <mailto:anshawn.lewis@navy.mil>