DEPARTMENT OF THE NAVY (DON)
19.3 Small Business Innovation Research (SBIR)
Proposal Submission Instructions for Technology Acceleration & Standard Topics

IMPORTANT

- DON is soliciting proposals against three distinct types of topics:
  - Technology Acceleration: N193-A01 to N193-A03
  - Standard: N193-138 to N193-149
  - Direct to Phase II: N193-D01 to N193-D03
- Each set of topics has a separate and unique set of proposal requirements and submission instructions.
- **This document includes instructions for the following topics**:
  - Technology Acceleration: Pages NAVY-2 through NAVY-9
  - Standard: Pages NAVY-10 through NAVY-17
- DON requires proposers to thoroughly review unique proposal requirements and submission instructions for topics of interest prior to proposal submission

INTRODUCTION

The Director of the DON SBIR/STTR Programs is Mr. Robert Smith. For program and administrative questions, contact the SYSCOM Program Manager listed in the table included in each set of instructions; **do not** contact them for technical questions. For technical questions about a topic, contact the Topic Authors listed for each topic during the period **23 August 2019 through 23 September 2019.** Beginning **24 September 2019,** the SBIR/STTR Interactive Technical Information System (SITIS) (https://sbir.defensebusiness.org/) listed in Section 4.15.d of the Department of Defense (DoD) SBIR/STTR Program Broad Agency Announcement (BAA) must be used for any technical inquiry. For general inquiries or problems with electronic submission, contact the DoD SBIR/STTR Help Desk at 1-800-348-0787 (Monday through Friday, 9:00 a.m. to 6:00 p.m. ET) or via email at sbirhelpdesk@u.group.

The DON SBIR/STTR Programs are mission-oriented programs that integrate the needs and requirements of the DON's Fleet through research and development (R&D) topics that have dual-use potential, but primarily address the needs of the DON. More information on the programs can be found on the DON SBIR/STTR website at www.navysbir.com. Additional information pertaining to the DON's mission can be obtained from the DON website at www.navy.mil.

(Continued on next page.)

DEPARTMENT OF THE NAVY (DON)
19.3 Small Business Innovation Research (SBIR)
PROPOSAL SUBMISSION INSTRUCTIONS – TECHNOLOGY ACCELERATION TOPICS

IMPORTANT

- **The following instructions apply to Technology Acceleration topics:**
  - **N193-A01**
  - **N193-A02**
  - **N193-A03**

- The DON provides notice that Basic Ordering Agreements (BOAs) will be used for Phase I and II awards. Further information on the BOAs will be made available on the Navy SBIR website: https://www.navysbir.com/.

- Selectees will be given the option to receive Phase I payments through a Government Purchase Card (GPC) or through Wide Area Workflow (WAWF).

- A Phase I proposal template, unique to Technology Acceleration topics, will be available prior to the BAA open date to assist small businesses to generate a Phase I Technical Volume (Volume 2). The template will be located on https://www.navysbir.com/links_forms.htm.

THE FOLLOWING INSTRUCTIONS SOLELY APPLY TO TECHNOLOGY ACCELERATION TOPICS (N193-A01 to N193-A03)

INTRODUCTION

The DON SBIR Program is conducting a Technology Acceleration pilot to seed a broader base of ideas and accelerate technology development to operational demonstration through streamlined evaluation, selection and contract award processes. Pilot activities are limited to the topics N193-A01 to N193-A03 and include requirements specified in the instructions below and summarized here:

Unique Technology Acceleration features and requirements:

- Five (5) page Technical Proposal (Volume 2)
- Phase I Base only, no Phase I Option
- Phase I Base cost not to exceed $150,000
- Phase I Base period of performance is five (5) months
- No discretionary Technical and Business Assistance (TABA) will be authorized for Phase I
- Technology Acceleration topics are broad in scope with multiple Focus Areas. Only **ONE** proposal will be accepted per firm per Technology Acceleration topic, therefore each proposer must select one Focus Area under which to propose. In the event a firm submits more than one proposal per Technology Acceleration topic, DON will only evaluate the proposal submission with the earliest date and time stamp – all other proposals submitted to the same Technology Acceleration topic by the same firm will be rejected.
- Basic Ordering Agreements (BOAs) will be put in place with selected firms, and delivery orders will be issued to award Phase I contracts.
- Phase I Kick-Off Presentation will be required as the first deliverable on the Phase I contract.
- In order to expedite funds, awardees choosing the option to receive payment via Government Purchase Card (GPC) MUST have the ability to accept card payments by the time of Phase I contract award. Please note, payment processing fees apply per transaction.
- Awardees who do not choose payment via GPC will be paid via Wide Area Workflow (WAWF)

- In-person demonstration of Phase I feasibility in Washington, DC in mid-June 2020.
- Cost of travel (2 days, 2 people) to Washington, DC in mid-June 2020 is to be included in the Cost Volume (Volume 3).

For program and administrative questions, contact the Program Managers listed in Table 1; **do not** contact them for technical questions.

TABLE 1: DON SYSTEMS COMMAND (SYSCOM) SBIR PROGRAM MANAGERS

Topic Numbers	Point of Contact	SYSCOM	Email
N193-A01	Ms. Donna Attick Focus Areas 1 - 6	Naval Air Systems Command (NAVAIR)	donna.attick@navy.mil
	Mr. Dean Putnam Focus Areas 7 – 8	Naval Sea Systems Command (NAVSEA)	dean.r.putnam@navy.mil
	Mr. Shadi Azoum Focus Area 9	Naval Information Warfare Systems Command (NAVWAR)	shadi.azoum@navy.mil
N193-A02	Mr. Dean Putnam	Naval Sea Systems Command (NAVSEA)	dean.r.putnam@navy.mil
N193-A03	Ms. Lore-Anne Ponirakis	Office of Naval Research (ONR)	loreanne.ponirakis@navy.mil

PHASE I GUIDELINES

Follow the instructions in the DoD SBIR/STTR Program BAA at https://sbir.defensebusiness.org/ for requirements and proposal submission guidelines. Please keep in mind that Phase I must address the feasibility of a solution to the topic**. It is highly recommended that proposers follow the Technology Acceleration Phase I Proposal Template** as a guide for structuring proposals. The template will be made available prior to the BAA open date, and will be located on https://navysbir.com/links_forms.htm. Inclusion of cost estimates for travel (2 days, 2 people) to Washington, DC in mid-June 2020 is required for all proposals.

PHASE I PROPOSAL SUBMISSION REQUIREMENTS

The following MUST BE MET or the Technology Acceleration topic proposal will be deemed noncompliant and will be REJECTED.

- **Proposal Cover Sheet (Volume 1).** As specified in DoD SBIR/STTR BAA section 5.4(a).

- **Technical Volume (Volume 2).** Technical Volume (Volume 2) must meet the following requirements:
  - Not to exceed five (5) pages, regardless of page content
  - Phase I Base period of performance only, no Phase I Option

- Single column format, single-spaced typed lines
- Standard 8 ½" x 11" paper
- Page margins one-inch on all sides. A header and footer may be included in the one-inch margin
- No font size smaller than 10-point*
- Content requirements as specified in the Technology Acceleration Phase I Proposal Template which will available prior to the BAA open date and will be located on https://navysbir.com/links_forms.htm. The content instructions in the template supersede DoD SBIR/STTR BAA sections 5.4(b) and (c).
- Include the Focus Area number for the topic you are proposing to as a prefix to the Phase I Proposal title. For example, "(2)" before the Proposal title to indicated Focus Area 2.

*For headers, footers, listed references, and imbedded tables, figures, images, or graphics that include text, a font size of smaller than 10-point is allowable; however, proposers are cautioned that the text may be unreadable by evaluators.

Volume 2 is the technical proposal. Additional documents may be submitted to support Volume 2 in accordance with the instructions for Supporting Documents Volume (Volume 5) as detailed below.

Disclosure of Information (DFARS 252.204-7000)
In order to eliminate the requirements for prior approval of public disclosure of information (in accordance with DFARS 252.204-7000) under this or any subsequent award, the proposer shall identify and describe all fundamental research to be performed under its proposal, including subcontracted work, with sufficient specificity to demonstrate that the work qualifies as fundamental research. Fundamental research means basic and applied research in science and engineering, the results of which ordinarily are published and shared broadly within the scientific community, as distinguished from proprietary research and from industrial development, design, production, and product utilization, the results of which ordinarily are restricted for proprietary or national security reasons. Simply identifying fundamental research in the proposal does NOT constitute acceptance of the exclusion. All exclusions will be reviewed and noted in the award. NOTE: Fundamental research included in the technical proposal that the proposer is requesting be eliminated from the requirements for prior approval of public disclosure of information, must be uploaded in a separate document (under "Other") in the Supporting Documents Volume (Volume 5).

- **Cost Volume (Volume 3).** The Phase I Base amount must not exceed $150,000. Costs for the Base must be clearly identified on the Proposal Cover Sheet (Volume 1) and in Volume 3. Volume 3 must include travel (2 days, 2 people) for an in-person demonstration of Phase I feasibility in Washington, DC in mid-June 2020.

- **Period of Performance.** The Phase I Base Period of Performance must not exceed five (5) months.

- **Company Commercialization Report (Volume 4)**. As specified in DoD SBIR/STTR BAA section 5.4(e).

- **Supporting Documents Volume (Volume 5)**. DoD has implemented a Supporting Documents Volume (Volume 5). Volume 5 **may** include the following optional documents:
  - Letters of Support relevant to this project

- Additional Cost Information - The "Explanatory Material" field in the online DoD Cost Volume (Volume 3) is to be used to provide sufficient detail for subcontractor, material, and travel costs. If additional space is needed these items may be included within Volume 5.
- SBIR/STTR Funding Agreement Certification
- Technical Data Rights (Assertions) - If required, must be provided in the table format required by DFARS 252.227-7013(d) and (e)(3) and be included within Volume 5.
- Allocation of Rights between the prime and subcontractor
- Disclosure of Information (DFARS 252.204-7000) (see Technical Volume 2 above)

Optional documents (as identified above) are intended to support the Technical Volume (Volume 2) and the Cost Volume (Volume 3). Volume 5 is available for use when submitting Phase I and Phase II proposals. DON will not be using any optional documents in Volume 5 during the evaluation.

NOTE: The inclusion of documents or information other than that listed above (e.g., resumes, test data, technical reports, publications) may result in the proposal being deemed "Non-compliant" and REJECTED.

A font size of smaller than 10-point is allowable for documents in Volume 5; however, proposers are cautioned that the text may be unreadable.

- **Fraud, Waste and Abuse Training Certification (Volume 6)**. DoD has implemented the optional Fraud, Waste and Abuse Training Certification (Volume 6). DON does not require evidence of Fraud, Waste and Abuse Training at the time of proposal submission. Therefore, DON will not require proposers to use Volume 6.

DON SBIR PHASE I PROPOSAL SUBMISSION CHECKLIST

- **Subcontractor, Material, and Travel Cost Detail.** In the Cost Volume (Volume 3), proposers must provide sufficient detail for subcontractor, material and travel costs. Enter this information in the "Explanatory Material" field in the online DoD Volume 3. Subcontractor costs must be detailed to the same level as the prime contractor. Material costs must include a listing of items and cost per item. Travel costs must include the purpose of the trip, number of trips, location, length of trip, and number of personnel. **Volume 3 must include travel (2 days, 2 people) for an in-person demonstration of Phase I feasibility in Washington, DC in mid-June 2020.** When a proposal is selected for award, be prepared to submit further documentation to the SYSCOM Contracting Officer to substantiate costs (e.g., an explanation of cost estimates for equipment, materials, and consultants or subcontractors).

- **System for Award Management (SAM).** It is critical that proposers to the Technology Acceleration topics are registered in SAM, www.sam.gov, by November 8, 2019 or verify their registration is still active and will not expire within 60 days of BAA close. Additionally, proposers should confirm that they are registered to receive contracts (not just grants) and the address in SAM matches the address on the proposal.

- **Performance Benchmarks.** Proposers must meet the two benchmark requirements for progress toward Commercialization as determined by the Small Business Administration (SBA) on June 1 each year. Please note that the DON applies performance benchmarks at time of proposal submission, not at time of contract award.

- **Discretionary Technical and Business Assistance (TABA).** Due to the shorter period of performance proposed under the Technology Acceleration pilot, TABA may not be proposed. TABA costs included in Volume 2 or 3 will be disapproved. Guidance for submitting TABA in Phase II will be provided to Phase I awardees.

EVALUATION AND SELECTION

The DON will evaluate and select Phase I and Phase II proposals using the evaluation criteria in Sections 6.0 and 8.0 of the DoD SBIR/STTR Program BAA respectively, with technical merit being most important, followed by qualifications of key personnel and commercialization potential of equal importance. As noted in the sections of the aforementioned Announcement on proposal submission requirements, proposals exceeding the total costs established for the Base and/or any Options as specified by the sponsoring DON SYSCOM will be rejected without evaluation or consideration for award. Due to limited funding, the DON reserves the right to limit awards under any topic.

Approximately one week after the Phase I BAA closing, e-mail notifications that proposals have been received and processed for evaluation will be sent. Consequently, the e-mail address on the proposal Cover Sheet must be correct.

Requests for a debrief must be made within 15 calendar days of select/non-select notification via email as specified in the select/non-select notification. Please note debriefs are typically provided in writing via email to the Corporate Official identified in the firm proposal within 60 days of receipt of the request. Requests for oral debriefs may not be accommodated. If contact information for the Corporate Official has changed since proposal submission, a notice of the change on company letterhead signed by the Corporate Official must accompany the debrief request.

Protests of Phase I and II selections and awards must be directed to the cognizant Contracting Officer for the DON Topic Number, or filed with the Government Accountability Office (GAO). Contact information for Contracting Officers may be obtained from the DON SYSCOM Program Managers listed in Table 1. If the protest is to be filed with the GAO, please refer to instructions provided in section 4.11 of the DoD SBIR/STTR Program BAA.

CONTRACT DELIVERABLES

Contract deliverables for Phase I are specified in Table 2.

Table 2: PHASE I DELIVERABLES (Required)

Deliverable	Due Date[1]	Delivery Method
Phase I Kick-Off Briefing Material	At contract award	Upload[2]
Progress Report	90 days from start of contract	Upload[2]
Phase II Proposal[3]	120 days from start of award	Upload[2]
Phase I Feasibility Briefing Materials[3]	120 days from start of award	Upload[2]
Draft Phase I Final Report	120 days from start of award	Upload[2]
Phase I Final Report and Report of Inventions and Subcontracts	150 days from start of award	Upload[2]

[1]Due dates are approximate; dates provided in Phase I contract take precedence over dates listed above.
[2] Uploaded to https://www.navysbirprogram.com/navydeliverables/.

[3] Required only for participation in a competitive Phase II evaluation and selection. If the proposer does **NOT** wish to be considered for Phase II, these deliverables are **NOT** required. Content requirements will be provided in the Phase I contract.

AWARD AND FUNDING LIMITATIONS

Awards. The DON provides notice that Basic Ordering Agreements (BOAs) may be used for Phase I and II awards. Historically, the DON has awarded a Firm Fixed Price (FFP) contract or a small purchase agreement for Phase I. In addition to the negotiated contract award types listed in Section 4.14.b of the DoD SBIR/STTR Program BAA for Phase II awards, the DON may (under appropriate circumstances) propose the use of an Other Transaction Agreement (OTA) as specified in 10 U.S.C. 2371/10 U.S.C. 2371b and related implementing policies and regulations.

Funding Limitations. In accordance with SBIR Policy Directive section 4(b)(5), there is a limit of one sequential Phase II award per firm per topic. Additionally, to adjust for inflation DON has raised Phase I and Phase II award amounts, excluding TABA. The maximum Phase I proposal/award amount is $150,000. The Phase I Base amount must not exceed $150,000 (no Phase I Options will be considered). The maximum Phase II proposal/award amount including all options (including TABA) is $1,600,000 (unless non-SBIR/STTR funding is being added). Individual SYSCOMs may award amounts, including Base and all Options, of less than $1,600,000 based on available funding. The structure of the Phase II proposal/award, including maximum amounts as well as breakdown between Base and Option amounts will be provided to all Phase I awardees either in their Phase I award or a minimum of 30 days prior to the due date for submission of their Phase II proposal (as identified in Table 2).

PAYMENTS

The DON plans to make three payments during the Phase I award. Payment amounts represent a percentage of the Phase I award as follows:

Days From Start of Base Award	Not to Exceed Payment Amount
1 Day	50% of Phase I Award
90 Days	35% of Phase I Award
150 Days	Balance of Phase I Award

TRANSFER BETWEEN SBIR AND STTR PROGRAMS

Section 4(b)(1)(i) of the SBIR Policy Directive provides that, at the agency's discretion, projects awarded a Phase I under a BAA for SBIR may transition in Phase II to STTR and vice versa. Please refer to instructions provided in section 7.2 of the DoD SBIR/STTR Program BAA.

ADDITIONAL NOTES

Human Subjects, Animal Testing, and Recombinant DNA. Due to the short timeframe associated with Phase I of the SBIR/STTR process, the DON does not recommend the submission of Phase I proposals that require the use of Human Subjects, Animal Testing, or Recombinant DNA. For example, the ability to obtain Institutional Review Board (IRB) approval for proposals that involve human subjects can take 6-12 months, and that lengthy process can be at odds with the Phase I goal for time-to-award. Before the DON makes any award that involves an IRB or similar approval requirement, the proposer must demonstrate compliance with relevant regulatory approval requirements that pertain to proposals involving human, animal, or recombinant DNA protocols. It will not impact the DON's evaluation, but requiring IRB approval may delay the start time of the Phase I award and if approvals are not obtained within two months of notification of selection, the decision to award may be terminated. If the use of human, animal, and

recombinant DNA is included under a Phase I or Phase II proposal, please carefully review the requirements at: http://www.onr.navy.mil/About-ONR/compliance-protections/Research-Protections/Human-Subject-Research.aspx. This webpage provides guidance and lists approvals that may be required before contract/work can begin.

Government Furnished Equipment (GFE). Due to the typical lengthy time for approval to obtain GFE, it is recommended that GFE is not proposed as part of the Phase I proposal. If GFE is proposed and it is determined during the proposal evaluation process to be unavailable, proposed GFE may be considered a weakness in the proposal.

International Traffic in Arms Regulation (ITAR). For topics indicating ITAR restrictions or the potential for classified work, limitations are generally placed on disclosure of information involving topics of a classified nature or those involving export control restrictions, which may curtail or preclude the involvement of universities and certain non-profit institutions beyond the basic research level. Small businesses must structure their proposals to clearly identify the work that will be performed that is of a basic research nature and how it can be segregated from work that falls under the classification and export control restrictions. As a result, information must also be provided on how efforts can be performed in later phases if the university/research institution is the source of critical knowledge, effort, or infrastructure (facilities and equipment).

Business Accelerator Services. The DON SBIR Program will implement a new Dual-Use Business Accelerator pilot in conjunction with this 19.3 BAA. As part of this pilot, the DON SBIR Program will offer all Phase I awardees under topic N193-A03 the opportunity to receive coaching on business and investor financing, market identification, and transition planning. The Accelerator will be virtual and will be adapted to individual company needs. While the Accelerator services will be provided free of charge, the participating companies must provide their own time and may choose to participate in events requiring some minimal optional travel expenses. Details on the Accelerator will be provided to awardees under topic N193-A03 at time of Phase I award.

PHASE II GUIDELINES

All Phase I awardees under the Technology Acceleration pilot may participate in the DON's competitive Phase II selection and award process. To be eligible for Phase II, Phase I awardees must submit the Phase I deliverables as specified in their Phase I contract (and referenced above in Table 2). Deliverables specific to the DON's competitive Phase II selection and award process will be due to the Government approximately 30 days before the end of the Phase I contract. Details on the due date, content, and submission requirements for Phase II will be provided by the awarding SYSCOM either in the Phase I contract or by subsequent notification. Phase II evaluation criteria are specified in DoD SBIR/STTR BAA section 8.0. Phase II selections will be based on an evaluation of the Phase II proposal, Draft Phase I Final Report, and an in-person demonstration of Phase I feasibility in Washington, DC in mid-June 2020. At the conclusion of the in-person demonstration of Phase I feasibility, each Phase I awardee will receive a select/non-select notification from the Government. If selected, it is the Government's intent to award Phase II contracts on-the-spot.

PHASE III GUIDELINES

A Phase III SBIR/STTR award is any work that derives from, extends, or completes effort(s) performed under prior SBIR/STTR funding agreements, but is funded by sources other than the SBIR/STTR programs. Thus, a Phase III award is any contract, grant, or agreement where the technology is the same as, derived from, or evolved from a Phase I or a Phase II SBIR/STTR award and given to the firm that received the

Phase I/II award. This covers any contract, grant, or agreement issued as a follow-on Phase III award or any contract, grant, or agreement award issued as a result of a competitive process where the awardee was an SBIR/STTR firm that developed the technology as a result of a Phase I or Phase II award. The DON will give Phase III status to any award that falls within the above-mentioned description, which includes assigning SBIR/STTR Technical Data Rights to any noncommercial technical data and/or noncommercial computer software delivered in Phase III that was developed under SBIR/STTR Phase I/II effort(s). Government prime contractors and/or their subcontractors must follow the same guidelines as above and ensure that companies operating on behalf of the DON protect the rights of the SBIR/STTR firm.

DEPARTMENT OF THE NAVY (DON)
19.3 Small Business Innovation Research (SBIR)
PROPOSAL SUBMISSION INSTRUCTIONS - STANDARD TOPICS

Proposal Submission Instructions – Standard Topics

IMPORTANT

- **The following instructions apply to Standard topics only:**
  - **N193-138 to N193-149**
- DON provides notice that Other Transaction Agreements (OTAs) may be used for Phase II awards.
- Discretionary Technical Assistance (DTA) was renamed Discretionary Technical and Business Assistance (TABA) for the SBIR 19.2 BAA.
- The optional Supporting Documents Volume (Volume 5) is available for the SBIR 19.3 BAA cycle. The optional Supporting Documents Volume is provided for small businesses to submit additional documentation to support the Technical Volume (Volume 2) and the Cost Volume (Volume 3). Volume 5 is available for use when submitting Phase I and Phase II proposals. DON will not be using any of the information in Volume 5 during the evaluation for Standard topics, N193-138 to N193-149.
- A Phase I proposal template is provided to assist small businesses to generate a Phase I Technical Volume (Volume 2).

THE FOLLOWING INSTRUCTIONS SOLELY APPLY TO STANDARD TOPICS (N193-138 to N193-149)

INTRODUCTION

The DON SBIR/STTR Programs are mission-oriented programs that integrate the needs and requirements of the DON's Fleet through research and development (R&D) topics that have dual-use potential, but primarily address the needs of the DON. More information on the programs can be found on the DON SBIR/STTR website at www.navysbir.com. Additional information pertaining to the DON's mission can be obtained from the DON website at www.navy.mil.

For program and administrative questions, contact the Program Managers listed in Table 3; **do not** contact them for technical questions.

TABLE 3: DON SYSTEMS COMMAND (SYSCOM) SBIR PROGRAM MANAGERS

Topic Numbers	Point of Contact	SYSCOM	Email
N193-138	Mr. Jeffrey Kent	Marine Corps Systems Command (MCSC)	jeffrey.a.kent@usmc.mil
N193-139 to N193-147	Ms. Donna Attick	Naval Air Systems Command (NAVAIR)	donna.attick@navy.mil

DEPARTMENT OF THE NAVY (DON)
19.3 Small Business Innovation Research (SBIR)
PROPOSAL SUBMISSION INSTRUCTIONS - STANDARD TOPICS

Topic Numbers	Point of Contact	SYSCOM	Email
N193-148	Mr. Timothy Petro	Naval Facilities Engineering Center (NAVFAC)	timothy.petro@navy.mil
N193-149	Mr. Shadi Azoum	Naval Information Warfare Systems Command (NAVWAR)	shadi.azoum@navy.mil

PHASE I GUIDELINES

Follow the instructions in the DoD SBIR/STTR Program BAA at https://sbir.defensebusiness.org/ for requirements and proposal submission guidelines. Please keep in mind that Phase I must address the feasibility of a solution to the topic. It is highly recommended that proposers follow the new DoD Phase I Proposal Template located on the Submission Web site (https://sbir.defensebusiness.org/) as a guide for structuring proposals. Inclusion of cost estimates for travel to the sponsoring SYSCOM's facility for one day of meetings is recommended for all proposals.

PHASE I PROPOSAL SUBMISSION REQUIREMENTS

The following MUST BE MET or the proposal will be deemed noncompliant and will be REJECTED.

- **Proposal Cover Sheet (Volume 1).** As specified in DoD SBIR/STTR BAA section 5.4(a).

- **Technical Volume (Volume 2).** Technical Volume (Volume 2) must meet the following requirements:
  - Not to exceed **20** pages, regardless of page content
  - Single column format, single-spaced typed lines
  - Standard 8 ½" x 11" paper
  - Page margins one-inch on all sides. A header and footer may be included in the one-inch margin.
  - No font size smaller than 10-point*
  - Include, within the **20-page limit of Volume 2**, an Option that furthers the effort in preparation for Phase II and will bridge the funding gap between the end of Phase I and the start of Phase II. Tasks for both the Phase I Base and the Phase I Option must be clearly identified.

  *For headers, footers, listed references, and imbedded tables, figures, images, or graphics that include text, a font size of smaller than 10-point is allowable; however, proposers are cautioned that the text may be unreadable by evaluators.

  Volume 2 is the technical proposal. Additional documents may be submitted to support Volume 2 in accordance with the instructions for Supporting Documents Volume (Volume 5) as detailed below.

  Disclosure of Information (DFARS 252.204-7000)
  In order to eliminate the requirements for prior approval of public disclosure of information (in accordance with DFARS 252.204-7000) under this or any subsequent award, the proposer shall identify and describe all fundamental research to be performed under its proposal, including subcontracted work, with sufficient specificity to demonstrate that the work qualifies as fundamental research. Fundamental research means basic and applied research in science and

engineering, the results of which ordinarily are published and shared broadly within the scientific community, as distinguished from proprietary research and from industrial development, design, production, and product utilization, the results of which ordinarily are restricted for proprietary or national security reasons. Simply identifying fundamental research in the proposal does NOT constitute acceptance of the exclusion. All exclusions will be reviewed and noted in the award. NOTE: Fundamental research included in the technical proposal that the proposer is requesting be eliminated from the requirements for prior approval of public disclosure of information, must be uploaded in a separate document (under "Other") in the Supporting Documents Volume (Volume 5).

Phase I Options are typically exercised upon selection for Phase II. Option tasks should be those tasks that would enable rapid transition from the Phase I feasibility effort into the Phase II prototype effort.

- **Cost Volume (Volume 3).** The Phase I Base amount must not exceed $140,000 and the Phase I Option amount must not exceed $100,000. Costs for the Base and Option must be separated and clearly identified on the Proposal Cover Sheet (Volume 1) and in Volume 3.

- **Period of Performance.** The Phase I Base Period of Performance must not exceed six (6) months and the Phase I Option Period of Performance must not exceed six (6) months.

- **Company Commercialization Report (Volume 4)**. As specified in DoD SBIR/STTR BAA section 5.4(e).

- **Supporting Documents Volume (Volume 5)**. DoD has implemented a Supporting Documents Volume (Volume 5). The optional Volume 5 is provided for small businesses to submit additional documentation to support the Technical Volume (Volume 2) and the Cost Volume (Volume 3). Volume 5 is available for use when submitting Phase I and Phase II proposals. DON will not be using any of the information in Volume 5 during the evaluation. Volume 5 must only be used for the following documents:
  - Letters of Support relevant to this project
  - Additional Cost Information - The "Explanatory Material" field in the online DoD Cost Volume (Volume 3) is to be used to provide sufficient detail for subcontractor, material, travel costs, and Discretionary Technical and Business Assistance (TABA), if proposed. If additional space is needed these items may be included within Volume 5.
  - SBIR/STTR Funding Agreement Certification
  - Technical Data Rights (Assertions) - If required, must be provided in the table format required by DFARS 252.227-7013(d) and (e)(3) and be included within Volume 5.
  - Allocation of Rights between prime and subcontractor
  - Disclosure of Information (DFARS 252.204-7000) (see Technical Volume 2 above)

  NOTE: The inclusion of documents or information other than that listed above (e.g., resumes, test data, technical reports, publications) may result in the proposal being deemed "Non-compliant" and REJECTED.

  A font size of smaller than 10-point is allowable for documents in Volume 5; however, proposers are cautioned that the text may be unreadable.

- **Fraud, Waste and Abuse Training Certification (Volume 6)**. DoD has implemented the optional Fraud, Waste and Abuse Training Certification (Volume 6). DON does not require evidence of Fraud, Waste and Abuse Training at the time of proposal submission. Therefore, DON will not require proposers to use Volume 6.

DON SBIR PHASE I PROPOSAL SUBMISSION CHECKLIST

- **Subcontractor, Material, and Travel Cost Detail.** In the Cost Volume (Volume 3), proposers must provide sufficient detail for subcontractor, material and travel costs. Enter this information in the "Explanatory Material" field in the online DoD Volume 3. Subcontractor costs must be detailed to the same level as the prime contractor. Material costs must include a listing of items and cost per item. Travel costs must include the purpose of the trip, number of trips, location, length of trip, and number of personnel. When a proposal is selected for award, be prepared to submit further documentation to the SYSCOM Contracting Officer to substantiate costs (e.g., an explanation of cost estimates for equipment, materials, and consultants or subcontractors).

- **Performance Benchmarks.** Proposers must meet the two benchmark requirements for progress toward Commercialization as determined by the Small Business Administration (SBA) on June 1 each year. Please note that the DON applies performance benchmarks at time of proposal submission, not at time of contract award.

- **Discretionary Technical and Business Assistance (TABA).** If TABA is proposed, the information required to support TABA (as specified in the TABA section below) must be added in the "Explanatory Material" field of the online DoD Volume 3. If the supporting information exceeds the character limits of the Explanatory Material field of Volume 3, this information must be included in Volume 5 as "Additional Cost Information" as noted above. Failure to add the required information in the online DoD Volume 3 and, if necessary, Volume 5 will result in the denial of TABA. TABA may be proposed in the Base and/or Option periods, but the total value may not exceed $6,500 in Phase I.

DISCRETIONARY TECHNICAL AND BUSINESS ASSISTANCE (TABA)

The SBIR Policy Directive section 9(b) allows the DON to provide TABA (formerly referred to as DTA) to its awardees. The purpose of TABA is to assist awardees in making better technical decisions on SBIR/STTR projects; solving technical problems that arise during SBIR/STTR projects; minimizing technical risks associated with SBIR/STTR projects; and commercializing the SBIR/STTR product or process, including intellectual property protections. Firms may request, in their Phase I Cost Volume (Volume 3) and Phase II Cost Volume, to contract these services themselves through one or more TABA providers in an amount not to exceed the values specified below. This amount is in addition to the award amount for the Phase I. The Phase II TABA amount is up to $25,000 per award. The TABA amount, of up to $25,000, is to be included as part of the award amount and is limited by the established award values for Phase II by the SYSCOM (i.e. within the $1,600,000 or lower limit specified by the SYSCOM). As with Phase I, the amount proposed for TABA cannot include any profit/fee application by the SBIR/STTR awardee and must be inclusive of all applicable indirect costs. A Phase II project may receive up to an additional $25,000 for TABA as part of one additional (subsequent) Phase II award under the project for a total TABA award of up to $50,000 per project.

Approval of direct funding for TABA will be evaluated by the DON SBIR/STTR Program Office. A detailed request for TABA must include:

- TABA provider (firm name)
- TABA provider point of contact, email address, and phone number

- An explanation of why the TABA provider is uniquely qualified to provide the service
- Tasks the TABA provider will perform
- Total TABA provider cost, number of hours, and labor rates (average/blended rate is acceptable)

TABA must NOT:

- Be subject to any profit or fee by the SBIR applicant
- Propose a TABA provider that is the SBIR applicant
- Propose a TABA provider that is an affiliate of the SBIR applicant
- Propose a TABA provider that is an investor of the SBIR applicant
- Propose a TABA provider that is a subcontractor or consultant of the requesting firm otherwise required as part of the paid portion of the research effort (e.g., research partner, consultant, tester, or administrative service provider)

TABA must be included in the Cost Volume (Volume 3) as follows:

- Phase I: The value of the TABA request must be included on the TABA line in the online DoD Volume 3 and, if necessary, Volume 5 as described above. The detailed request for TABA (as specified above) must be included in the "Explanatory Material" field of the online DoD Volume 3 and be specifically identified as "Discretionary Technical and Business Assistance".
- Phase II: The value of the TABA request must be included on the TABA line in the DON Phase II Cost Volume (provided by the DON SYSCOM). The detailed request for TABA (as specified above) must be included as a note in the Phase II Cost Volume and be specifically identified as "Discretionary Technical and Business Assistance".

TABA may be proposed in the Base and/or Option periods. Proposed values for TABA must NOT exceed:

- Phase I: A total of $6,500
- Phase II: A total of $25,000 per award, not to exceed $50,000 per Phase II project

NOTE: The Small Business Administration (SBA) is currently developing regulations governing TABA reporting and other limitations. All regulatory guidance produced by SBA will apply to any SBIR contracts where TABA is utilized only after the Government Contracting Officer issues a modification to the contract.

If a proposer requests and is awarded TABA in a Phase II contract, the proposer will be eliminated from participating in the DON SBIR/STTR Transition Program (STP), the DON Forum for SBIR/STTR Transition (FST), and any other assistance the DON provides directly to awardees.

All Phase II awardees not receiving funds for TABA in their awards must attend a one-day DON STP meeting during the first or second year of the Phase II contract. This meeting is typically held in the spring/summer in the Washington, D.C. area. STP information can be obtained at: https://navystp.com. Phase II awardees will be contacted separately regarding this program. It is recommended that Phase II cost estimates include travel to Washington, D.C. for this event.

EVALUATION AND SELECTION

The DON will evaluate and select Phase I and Phase II proposals using the evaluation criteria in Sections 6.0 and 8.0 of the DoD SBIR/STTR Program BAA respectively, with technical merit being most important, followed by qualifications of key personnel and commercialization potential of equal importance. As noted in the sections of the aforementioned Announcement on proposal submission requirements, proposals exceeding the total costs established for the Base and/or any Options as specified by the sponsoring DON

SYSCOM will be rejected without evaluation or consideration for award. Due to limited funding, the DON reserves the right to limit the number of awards under any topic.

Approximately one week after the Phase I BAA closing, e-mail notifications that proposals have been received and processed for evaluation will be sent. Consequently, the e-mail address on the proposal Cover Sheet must be correct.

Requests for a debrief must be made within 15 calendar days of select/non-select notification via email as specified in the select/non-select notification. Please note debriefs are typically provided in writing via email to the Corporate Official identified in the firm proposal within 60 days of receipt of the request. Requests for oral debriefs may not be accommodated. If contact information for the Corporate Official has changed since proposal submission, a notice of the change on company letterhead signed by the Corporate Official must accompany the debrief request.

Protests of Phase I and II selections and awards must be directed to the cognizant Contracting Officer for the DON Topic Number, or filed with the Government Accountability Office (GAO). Contact information for Contracting Officers may be obtained from the DON SYSCOM Program Managers listed in Table 1. If the protest is to be filed with the GAO, please refer to instructions provided in section 4.11 of the DoD SBIR/STTR Program BAA.

CONTRACT DELIVERABLES
Contract deliverables for Phase I are typically a kick-off brief, progress reports, and a final report. Required contract deliverables must be uploaded to https://www.navysbirprogram.com/navydeliverables/.

AWARD AND FUNDING LIMITATIONS
Awards. The DON typically awards a Firm Fixed Price (FFP) contract or a small purchase agreement for Phase I. In addition to the negotiated contract award types listed in Section 4.14.b of the DoD SBIR/STTR Program BAA for Phase II awards, the DON may (under appropriate circumstances) propose the use of an Other Transaction Agreement (OTA) as specified in 10 U.S.C. 2371/10 U.S.C. 2371b and related implementing policies and regulations.

Funding Limitations. In accordance with SBIR Policy Directive section 4(b)(5), there is a limit of one sequential Phase II award per firm per topic. Additionally, to adjust for inflation DON has raised Phase I and Phase II award amounts, excluding TABA. The maximum Phase I proposal/award amount including all options (less TABA) is $240,000. The Phase I Base amount must not exceed $140,000 and the Phase I Option amount must not exceed $100,000. The maximum Phase II proposal/award amount including all options (including TABA) is $1,600,000 (unless non-SBIR/STTR funding is being added). Individual SYSCOMs may award amounts, including Base and all Options, of less than $1,600,000 based on available funding. The structure of the Phase II proposal/award, including maximum amounts as well as breakdown between Base and Option amounts will be provided to all Phase I awardees either in their Phase I award or a minimum of 30 days prior to the due date for submission of their Initial Phase II proposal.

PAYMENTS
The DON makes three payments from the start of the Phase I Base period, and from the start of the Phase I Option period, if exercised. Payment amounts represent a set percentage of the Base or Option value as follows:

Days From Start of Base Award or Option	Payment Amount
15 Days	50% of Total Base or Option

90 Days	35% of Total Base or Option
180 Days	15% of Total Base or Option

TRANSFER BETWEEN SBIR AND STTR PROGRAMS

Section 4(b)(1)(i) of the SBIR Policy Directive provides that, at the agency's discretion, projects awarded a Phase I under a BAA for SBIR may transition in Phase II to STTR and vice versa. Please refer to instructions provided in section 7.2 of the DoD SBIR/STTR Program BAA.

ADDITIONAL NOTES

Human Subjects, Animal Testing, and Recombinant DNA. Due to the short timeframe associated with Phase I of the SBIR/STTR process, the DON does not recommend the submission of Phase I proposals that require the use of Human Subjects, Animal Testing, or Recombinant DNA. For example, the ability to obtain Institutional Review Board (IRB) approval for proposals that involve human subjects can take 6-12 months, and that lengthy process can be at odds with the Phase I goal for time-to-award. Before the DON makes any award that involves an IRB or similar approval requirement, the proposer must demonstrate compliance with relevant regulatory approval requirements that pertain to proposals involving human, animal, or recombinant DNA protocols. It will not impact the DON's evaluation, but requiring IRB approval may delay the start time of the Phase I award and if approvals are not obtained within two months of notification of selection, the decision to award may be terminated. If the use of human, animal, and recombinant DNA is included under a Phase I or Phase II proposal, please carefully review the requirements at: http://www.onr.navy.mil/About-ONR/compliance-protections/Research-Protections/Human-Subject-Research.aspx. This webpage provides guidance and lists approvals that may be required before contract/work can begin.

Government Furnished Equipment (GFE). Due to the typical lengthy time for approval to obtain GFE, it is recommended that GFE is not proposed as part of the Phase I proposal. If GFE is proposed and it is determined during the proposal evaluation process to be unavailable, proposed GFE may be considered a weakness in the proposal.

International Traffic in Arms Regulation (ITAR). For topics indicating ITAR restrictions or the potential for classified work, limitations are generally placed on disclosure of information involving topics of a classified nature or those involving export control restrictions, which may curtail or preclude the involvement of universities and certain non-profit institutions beyond the basic research level. Small businesses must structure their proposals to clearly identify the work that will be performed that is of a basic research nature and how it can be segregated from work that falls under the classification and export control restrictions. As a result, information must also be provided on how efforts can be performed in later phases if the university/research institution is the source of critical knowledge, effort, or infrastructure (facilities and equipment).

PHASE II GUIDELINES

All Phase I awardees can submit an **Initial** Phase II proposal for evaluation and selection. The Phase I Final Report, Initial Phase II Proposal, and Transition Outbrief (as applicable) will be used to evaluate the proposer's potential to progress to a workable prototype in Phase II and transition technology to Phase III. Details on the due date, content, and submission requirements of the Initial Phase II Proposal will be provided by the awarding SYSCOM either in the Phase I contract or by subsequent notification.

NOTE: All SBIR/STTR Phase II awards made on topics from solicitations prior to FY13 will be conducted in accordance with the procedures specified in those solicitations (for all DON topics, this means by invitation only).

The DON typically awards a Cost Plus Fixed Fee contract for Phase II; but, may consider other types of agreement vehicles. Phase II awards can be structured in a way that allows for increased funding levels based on the project's transition potential. To accelerate the transition of SBIR/STTR-funded technologies to Phase III, especially those that lead to Programs of Record and fielded systems, the Commercialization Readiness Program was authorized and created as part of section 5122 of the National Defense Authorization Act of Fiscal Year 2012. The statute set-aside is 1% of the available SBIR/STTR funding to be used for administrative support to accelerate transition of SBIR/STTR-developed technologies and provide non-financial resources for the firms (e.g., the DON STP).

PHASE III GUIDELINES

A Phase III SBIR/STTR award is any work that derives from, extends, or completes effort(s) performed under prior SBIR/STTR funding agreements, but is funded by sources other than the SBIR/STTR programs. Thus, a Phase III award is any contract, grant, or agreement where the technology is the same as, derived from, or evolved from a Phase I or a Phase II SBIR/STTR award and given to the firm that received the Phase I/II award. This covers any contract, grant, or agreement issued as a follow-on Phase III award or any contract, grant, or agreement award issued as a result of a competitive process where the awardee was an SBIR/STTR firm that developed the technology as a result of a Phase I or Phase II award. The DON will give Phase III status to any award that falls within the above-mentioned description, which includes assigning SBIR/STTR Technical Data Rights to any noncommercial technical data and/or noncommercial computer software delivered in Phase III that was developed under SBIR/STTR Phase I/II effort(s). Government prime contractors and/or their subcontractors must follow the same guidelines as above and ensure that companies operating on behalf of the DON protect the rights of the SBIR/STTR firm.

DEPARTMENT OF THE NAVY (DON)
19.3 Small Business Innovation Research (SBIR)

NAVY Topic Index

Technology Acceleration Topics – N193-A01 to N193-A03

Standard Topics – N193-138 to N193-149

DEPARTMENT OF THE NAVY (DON)
19.3 Small Business Innovation Research (SBIR)

NAVY SBIR 19.3 Topic Descriptions

Technology Acceleration Topics – N193-A01 to N193-A03

N193-A01 TITLE: NAVY TECHNOLOGY ACCELERATION - Machine Learning (ML) and Artificial Intelligence (AI) to Develop Capabilities and Impact Mission Success

TECHNOLOGY AREA(S): Information Systems

ACQUISITION PROGRAM: Broad ranging topic related to AI/ML in support of the Navy Technology Acceleration Pilot.

The technology within this topic is restricted under the International Traffic in Arms Regulation (ITAR), 22 CFR Parts 120-130, which controls the export and import of defense-related material and services, including export of sensitive technical data, or the Export Administration Regulation (EAR), 15 CFR Parts 730-774, which controls dual use items. Offerors must disclose any proposed use of foreign nationals (FNs), their country(ies) of origin, the type of visa or work permit possessed, and the statement of work (SOW) tasks intended for accomplishment by the FN(s) in accordance with section 3.5 of the Announcement. Offerors are advised foreign nationals proposed to perform on this topic may be restricted due to the technical data under US Export Control Laws.

OBJECTIVE: Develop artificial intelligence (AI)/machine learning (ML) capabilities to address a variety of use cases that expand outside the current field of focus of the Navy. Technologies should address capability development, testing and certifying AI/ML algorithms, Readiness and Sustainment, as well as enable analyses of massive quantities of data in a multitude of applications with a shared focus on program and fleet success.

DESCRIPTION: The Department of the Navy is interested in the development of cutting-edge AI/ML technologies and intends to collaborate with innovative small businesses to obtain solutions to the following and related Navy Focus Areas. Submit no more than one proposal per topic to one of the following Focus Areas:

1 - Readiness and Sustainment
2 - Unmanned Aircraft Systems Autonomy and Automation
3 - Predictive Maintenance
4 - Cyber
5 - Counter Artificial Intelligence
6 - Streamline Business Operations
7 - Integration of Automatic Dependent Surveillance
8 - Integration of Automatic Identification System (AIS) Data through AI/ML Applications
9 - C4ISR (Test/Certify)

1. Readiness and Sustainment - Maintaining inventories and supply chains is a critical function within Naval Air operations; this becomes especially important in keeping a frontline offensive supplied and ready. This process involves keeping suppliers aware of current demands and the flow of supplies to the destination. Aircraft readiness depends significantly on efficient supply chain. Currently, the acquisition software and databases embedded with bad data make it difficult to track parts. This affects the prediction of supply chain needs, making detection by humans improbable. Errors in the data propagate within the databases, causing major delays. Using AI/ML protocols to identify such errors, and applying deep learning techniques with pattern analysis, can cleanse the data error in short intervals. AI/ML protocols can also uncover relationships between variables and clusters, currently an expertise limited to experts.

Develop innovative AI/ML technologies that can predict and prescribe items for resupply. Develop innovative technologies that utilize AI/ML techniques and collaborative planning to address efficient logistics support, maintain inventories, reduce waste, allocate spare parts, and optimize inventory levels. Demonstrate scalability and trouble-shooting to enable rapid deployment of agile, adaptable forces at reduced costs. Successful development will enable the warfighter to receive the correct material at the right time and place, contributing to increased readiness and

sustainment.

2. Unmanned Aircraft Systems Autonomy and Automation - Develop AI/ML solutions for unmanned systems with a focus on capability development, autonomy, and automation. Software architectures and systems capabilities often define Navy unmanned assets whether they are unmanned aerial systems (UAS) or weapon systems. Accurate perception of the surroundings is critical to accomplish unmanned missions. Work in the area of image understanding of "standard" electro-optical/visual (EO) imagery has been characterized by sharp, well lit, and well framed features, rather than lesser quality images or "non-optical" imagery such as those from IR (infrared), SAR (synthetic aperture radar), and ISAR (inverted SAR).

Explore and develop advanced image understanding techniques, such as multimodal imagery, in conjunction with sensor fusing. Architectures and implementations contain vulnerabilities that put survivability of systems at risk, often making them the target of cyber-attacks. Leverage AI/ML techniques to design, develop, and test processes that increase the resilience and survivability of critical UAS/weapon/weapons systems software through optimization of implementation and architectures that consider both failures due to mistakes and events perpetrated by adversaries.

3. Predictive Maintenance - Predictive maintenance applications, such as condition-based maintenance, have huge potential for supporting fleet forces and driving efficiencies. Develop novel approaches that predict and mitigate the failure of critical parts, target aircraft mission degraders such as foreign object debris and corrosion, automate diagnostics, and plan maintenance based on data and equipment conditions. Produce prototypes of predictive maintenance solutions and demonstrate scalability. Such AI/ML based applications have the potential to predict, more accurately, maintenance needs on equipment. Such solutions will significantly improve availability of aircraft on the flight line, increase operational readiness, and reduce life cycle costs.

4. Cyber - Cyber risk assessment and management of the Navy's weapons and weapons systems, quantification and understanding of risk provides temporary results based upon information available at the time of the assessment, and the risk to platforms in cyber-contested environments changes rapidly. Develop tools and techniques using AI/ML and analytic techniques to accumulate and integrate internal/external information, to report risk in near real-time. The developed system should be able to identify trends and emerging risks based on historical and current information, as well as provide risk measures of the mission through the development of key risk indicators, key performance indicators, and associated threat measures. The resulting system would extend the concept of CYBERSAFE to a near real-time environment using the results of those processes as a baseline.

5. Counter Artificial Intelligence - Methods used to trick AI/ML techniques, something as simple as changing a pixel in a common picture derived out of AI/ML techniques, can lead to misclassification of the image, resulting in unintended consequences; the system programmed to identify the subject of the photo is unable to do that through a small tweak. That said we must to determine if AI/ML can be trusted to interpret data correctly and act accordingly.

Develop innovative approaches such as complimentary classifiers and meta-reasoners to understand such failure modes, propose mitigation plans to prevent deceit of AI/ML algorithms, leading to resilient systems. Such solutions enhance AI/ML techniques' capabilities, delivering results that can be trusted and validated, and on par with human-like performance.

6. Streamline Business Operations – The DoD workforce dedicates time and effort on highly manual, repetitive tasks that are prone to errors. AI/ML technologies have the potential to reduce the number and cost of mistakes, increase productivity, and allow allocation of DoD resources to higher-level and mission-priority activities. As an example, the workforce is investing significant time and money to assess the current state of projects, with respect to cost, schedule, and performance. Often, the earned value management processes fall short of identifying real problems with a project during its duration. Data driven AI/ML techniques could identify such risks, optimize allocation of resources, and automate mundane project tasks. Develop innovative approaches applying AI/ML techniques for project management capacities, human capital management, workforce productivity and efficiency enhancement, and automation of business systems and digital workflow, which connect data and processes at the enterprise level to drive better business outcomes.

7. Integration of Automatic Dependent Surveillance – Broadcast (ADS-B) data through AI/ML Applications: The ADS-B data are obtained from publicly available sources. The Navy seeks to develop models and algorithms through AI/ML processes to autonomously characterize behaviors of self-reporting aircraft using ADS-B data. The behavior models and data will be used to (1) identify apparent air corridors and (2) detect anomalous behavior in support of determining aircraft intent.

8. Integration of Automatic Identification System (AIS) Data through AI/ML Applications - AIS data are obtained from publicly available sources. The Navy seeks to develop models and algorithms using AI/ML processes to autonomously characterize behaviors of self-reporting maritime traffic using AIS data in order to use these behavioral models and data to (1) identify apparent shipping lanes and (2) detect anomalous behavior in support of determining surface vessel intent.

9. C4ISR (Test/Certify) – Trusted and reliable AI technologies can be used to enhance mission capability and increase the performance of many types of Naval systems. Recent advances in ML are improving countless technologies from image classifiers to game playing, with the potential to revolutionize innumerable others, from natural language processing to robotics. However, the current ability to leverage advancements are limited because no reliable method exists for testing and certification of the outputs of these systems. Therefore, the Navy is seeking innovative solutions to enable the transformation of opaque ML and AI systems into trusted and understandable systems, necessary for the warfighter to utilize these advanced systems reliably to achieve mission goals.

Develop appropriate framework and methods to test and certify ML and AI algorithms and systems using ML and AI technologies for Program Executive Office for Command, Control, Communications, Computers and Intelligence (PEO C4I). Successful methods will provide an effective and efficient way to test and certify Navy systems utilization of ML and AI algorithms and allow acquisition and fielding.

Awardees should conduct testing in an operationally relevant environment with final testing by the Navy. Validation, testing, qualification, and certification for Navy use across a wide range of conditions as applicable for the relevant class of problem will be conducted.

Work produced in Phase II may become classified. Note: The prospective contractor(s) must be U.S. Owned and Operated with no Foreign Influence as defined by DOD 5220.22-M, National Industrial Security Program Operating Manual, unless acceptable mitigating procedures can and have been be implemented and approved by the Defense Security Service (DSS). The selected contractor and/or subcontractor must be able to acquire and maintain a secret level facility and Personnel Security Clearances, in order to perform on advanced phases of this contract as set forth by DSS and the awarding NAVY SYSCOM in order to gain access to classified information pertaining to the national defense of the United States and its allies; this will be an inherent requirement. The selected company will be required to safeguard classified material IAW DoD 5220.22-M during the advance phases of this contract.

PHASE I: NOTE: Please add the Focus Area number you are proposing to as a prefix to the Phase I Proposal title.

Develop a solution to address one or more of the use cases outlined in the Description and demonstrate the feasibility of that concept. Assure data integrity that is representative of affected processes. Feasibility can also be established through modeling, simulation, and analysis. A high-level description of the intended approach for Phase II should be included in the Phase I proposal.

PHASE II: Based upon the results of Phase I, develop, demonstrate functionality and deliver prototype systems for testing and evaluation. The prototype system will vary based on the proposed approach, but it may include hardware and software.

It is probable that the work under this effort could become classified under Phase II (see Description section for details).

PHASE III DUAL USE APPLICATIONS: Transition the technology developed to improve and expand mission capability to a potentially broad range of government programs and entities. Commercialize the various technologies

developed to civilian entities with alternate mission needs.

REFERENCES:
1. VADM Dean Peters article (USNI June 14, 2018) calling for readiness improvements that our AI application is uniquely qualified to enable throughout the FRCs depots space. https://news.usni.org/2018/06/14/navair-to-develop-modernization-plan-for-3-depots

2. During October 2018 NRDE A2I Summit in San Diego, RADM David Hahn challenged attendees (government and industry) to find ways to "take AI to scale" and to accelerate AI-enabled technologies into the Fleet "at the speed of industry."

3. “Summary of the 2018 department of defense artificial intelligence strategy”, Accessible from https://media.defense.gov/2019/Feb/12/2002088963/-1/-1/1/SUMMARY-OF-DOD-AI-STRATEGY.PDF, February 2019.

4. U.S. Department of Homeland Security, “Automatic Identification System Overview”, United States Coast Guard. 17 November 2018 https://www.navcen.uscg.gov/?pageName=aismain.

5. Bishop, Christopher. Pattern Recognition and Machine Learning. New York, Springer-Verlag, 2006 https://www.springer.com/us/book/9780387310732.

6. U.S. Department of Transportation, “Automatic Dependent Surveillance-Broadcast (ADS-B)”, Federal Aviation Administration. 17 November 2018. https://www.faa.gov/nextgen/programs/adsb/.

7. Castelvecchi, D. The Black Box of AI. Nature 538, 2016, pp. 20-23.

8. Russell, S.R., and P. Norvig. Artificial Intelligence: A Modern Approach. Upper Saddle River, NJ: Prentice Hall, 2015.

KEYWORDS: Artificial Intelligence; Neural Networks; Big Data; Machine Learning (ML); Data Analysis; Sustainment and Readiness; Automatic Dependent Surveillance-Broadcast (ADS-B); Automatic Identification System (AIS); Testing & Evaluation; Certification

Questions may also be submitted through DOD SBIR/STTR SITIS website.

N193-A02 TITLE: NAVY TECHNOLOGY ACCELERATION - Unmanned Surface Vehicle (USV) and Unmanned Underwater Vehicle (UUV) Autonomous Behavior Development

TECHNOLOGY AREA(S): Ground/Sea Vehicles

ACQUISITION PROGRAM: PMS 406, Unmanned Maritime Systems Program Office

The technology within this topic is restricted under the International Traffic in Arms Regulation (ITAR), 22 CFR Parts 120-130, which controls the export and import of defense-related material and services, including export of sensitive technical data, or the Export Administration Regulation (EAR), 15 CFR Parts 730-774, which controls dual use items. Offerors must disclose any proposed use of foreign nationals (FNs), their country(ies) of origin, the type of visa or work permit possessed, and the statement of work (SOW) tasks intended for accomplishment by the FN(s) in accordance with section 3.5 of the Announcement. Offerors are advised foreign nationals proposed to perform on this topic may be restricted due to the technical data under US Export Control Laws.

OBJECTIVE: Develop autonomous behaviors so that an Unmanned Surface Vehicle (USV) and/or an Unmanned Undersea Vehicle (UUV) can respond to a given situation like a manned surface ship or submarine.

DESCRIPTION: The small business should develop software or a combination of software and hardware that would enable a behavior in one of the five classes listed below. The proposed solution can be for USVs, UUVs, or both. The Navy is seeking a broad range of emerging technologies that can utilize machine learning and/or artificial intelligence as potential solutions. This will increase mission capability by allowing USVs and UUVs to perform their missions without communicating with a distant control station. No current commercial technologies exist that have the military applications that the Navy seeks. Submit no more than one proposal per topic to one of the following Focus Areas:

1 - Storm Avoidance and In-storm Maneuvering (USV only)
2 - Perception
3 - In-stride Detection of Sensor Degradation
4 - Automated Pattern and Anomaly Recognition
5 - Classification of Surface and Subsurface Vessels

1. Storm Avoidance and In-storm Maneuvering (USV only): A USV needs to weigh mission accomplishment against potential damage from high seas. Once in a high-seas situation, the best immediate course and speed to minimize vessel motions may not coincide with the best path away from the storm. The USV needs a maneuvering behavior that balances overall mission accomplishment, immediate avoidance of excessive motions, and longer-term maneuvering away from projected high-seas areas.

2. Perception: A UUV or USV needs to accurately perceive its surroundings in order to accomplish its mission. Behaviors that improve perception could include choosing a course, speed, and depth combination that minimize vehicle vibration or deviations from base course, turning in order to optimize sensor "view" of a given object, closing range to an object, circling an object, or minimizing other power uses to allow maximum power output of a chosen sensor. Other behaviors, or combinations of behaviors, are possible. The optimal behavior may depend on the object of interest, USV/UUV sensor capabilities, and environmental conditions.

3. In-stride Detection of Sensor Degradation: During a mission, sensor inputs may degrade over time. Novel approaches are sought to detect such degradation and adjust accordingly. Detection of degradation requires determining if changes in environmental conditions or target behavior/type may be the cause. If the degradation is determined to be within the sensor, possible approaches include adjustment or re-calibration techniques, re-initialization of the sensor, or adjusted tactics to compensate for the degraded sensor. The USV/UUV might also have an option to send a snippet of raw sensor data back to a controlling platform for confirmation of a problem by a human operator. Approaches could also include a method for computing the value of continuing the mission with the degraded sensor and comparing it to the value of returning immediately to the host platform or maintenance location for repairs.

4. Automated Pattern and Anomaly Recognition: During each mission, the USV/UUV will ingest a rich stream of data unlike any previous mission. In a manned submarine, the human operator excels at recognizing patterns as well as anomalies. Novel approaches are sought to enable the USV/UUV to more closely approach that human capability of figuring out what is essentially the same or "normal", and identifying situations and objects that are both unusual and important.

5. Classification of Surface and Subsurface Vessels: The USV/UUV will encounter surface and subsurface vessels during its sorties. Novel approaches are sought to solve the problem of classifying such vessels. At the coarse level, a vessel should be classified as friendly, neutral, or adversary; the neutral category would include most merchant, fishing, and pleasure craft. A finer classification could be at the level of vessel type, or even the specific vessel by name or other identifier. Approaches could be based on a single sensor, multiple sensors, analysis of behavior compared to previously learned patterns, or combinations of these. Any solutions that help identify a warship or naval auxiliary that is pretending to be something else are particularly of interest.

Testing will be conducted by the small business in an operationally relevant environment with final testing by the

Navy at sea. The product will be validated, tested, qualified, and certified for Navy use in at-sea trials across a wide range of conditions as applicable for the relevant class of problem.

Work produced in Phase II may become classified. Note: The prospective contractor(s) must be U.S. Owned and Operated with no Foreign Influence as defined by DOD 5220.22-M, National Industrial Security Program Operating Manual, unless acceptable mitigating procedures can and have been be implemented and approved by the Defense Security Service (DSS). The selected contractor and/or subcontractor must be able to acquire and maintain a secret level facility and Personnel Security Clearances, in order to perform on advanced phases of this contract as set forth by DSS and NAVSEA in order to gain access to classified information pertaining to the national defense of the United States and its allies; this will be an inherent requirement. The selected company will be required to safeguard classified material IAW DoD 5220.22-M during the advance phases of this contract.

PHASE I: NOTE: Please add the Focus Area number you are proposing to as a prefix to the Phase I Proposal title.

Provide a concept to solve the Navy's problem as stated and demonstrate the feasibility of that concept. The expected product in Phase I may either be software or a combination of hardware and software. Concept feasibility can be demonstrated by analysis, laboratory bench test, or limited scale field experiment. An example concept might use a fixed sensor at a point ashore viewing vessels in a harbor or at sea close to shore, with associated recognition software. (Note: Proposers are expected to include proof of concept feasibility as part of their proposals.)

PHASE II: Develop and deliver prototype systems that may include hardware and software for testing and evaluation based on the results of Phase I. (Note: The hardware may be a commercial system, or it could be a Navy-provided system.) Evaluate the prototype at sea, either from a Navy USV, a Navy UUV, or a surrogate vessel. Perform additional laboratory testing, modeling, or analytical methods as appropriate depending on the company's proposed approach. Provide two prototypes to the Government for testing, at least three months prior to the end of Phase II. Produce a Phase III development plan at the end of Phase II.

It is probable that the work under this effort could be classified under Phase II or Phase III (see Description section for details).

PHASE III DUAL USE APPLICATIONS: Support the Navy in transitioning the technology to Navy use. The final product will be software integrated with Navy-provided hardware, or software integrated with company-provided hardware. The Navy expects companies to support transition to Phase III through system integration, testing support, software and hardware documentation, and limited hardware production if applicable. Possible platforms where the technology will be used include the Medium Unmanned Surface Vehicle (MUSV), the Large Unmanned Surface Vessel (LUSV), the Large Displacement Unmanned Undersea Vehicle (LDUUV), and the Extra Large Unmanned Undersea Vehicle (XLUUV). The technology will meet critical Navy needs in USV and/or UUV operations, as applicable to the class of solution. In Phase III, the product will be validated, tested, qualified, and certified for Navy use in at-sea trials across a wide range of conditions as applicable for the relevant class of problem. Additional software testing will likely also be required to ensure that all applicable conditions can be tested even if they do not occur during at-sea test periods.

All of these solutions have potential for dual use in unmanned or minimally manned commercial ships or UUVs.

REFERENCES:
1. Prpic-Oršic, Jasna, Parunov, Joško, and Šikic, Igor. "Operation of ULCS-real life." International Journal of Naval Architecture and Ocean Engineering 6, no. 4, 2014, pp. 1014-1023.
https://www.researchgate.net/publication/277911664_Operation_of_ULCS_-_real_life

2. Polvara, Riccardo, Sharma, Sanjay, Wan, Jian, Manning, Andrew, and Robert Sutton. "Obstacle avoidance approaches for autonomous navigation of unmanned surface vehicles." The Journal of Navigation 71, no. 1, 2018, pp. 241-256.
https://www.researchgate.net/publication/320309314_Obstacle_Avoidance_Approaches_for_Autonomous_Navigati

on_of_Unmanned_Surface_Vehicles

3. Liu, Zhixiang, Zhang, Youmin, Yu, Xiang, and Yuan, Chi. "Unmanned surface vehicles: An overview of developments and challenges." Annual Reviews in Control 41, 2016. pp. 71-93. https://www.researchgate.net/publication/301831885_Unmanned_surface_vehicles_An_overview_of_developments_and_challenges

4. Jiang, Li, Djurdjanovic, Dragan, and Ni, Jun. "A new method for sensor degradation detection, isolation and compensation in linear systems." American Society of Mechanical Engineers (ASME) 2007 International Mechanical Engineering Congress and Exposition, pp. 1089-1101. https://www.researchgate.net/publication/267590208_A_New_Method_for_Sensor_Degradation_Detection_Isolation_and_Compensation_in_Linear_Systems

5. Sodemann, Angela A., Ross, Matthew P., and Borghetti, Brett J. "A review of anomaly detection in automated surveillance." IEEE Transactions on Systems, Man, and Cybernetics, Part C (Applications and Reviews) 42, no. 6, 2012, pp. 1257-1272. https://ieeexplore.ieee.org/document/6392472

KEYWORDS: Heavy Seas Avoidance Software; USV Perception; Sensor Degradation Detection; Automated Anomaly Detection; Automated Vessel Detection; Automated Vessel Classification

Questions may also be submitted through DOD SBIR/STTR SITIS website.

N193-A03 TITLE: NAVY TECHNOLOGY ACCELERATION - Advanced Technologies (including AR/VR) for Manpower, Personnel, Training, and Education

TECHNOLOGY AREA(S): Battlespace, Human Systems

ACQUISITION PROGRAM: OPNAV N9 - FTWC, OPNAV N1 - 21st Century Sailor, PEO-IWS1IT - TSTC, USMC TECOM, and USFF N72

The technology within this topic is restricted under the International Traffic in Arms Regulation (ITAR), 22 CFR Parts 120-130, which controls the export and import of defense-related material and services, including export of sensitive technical data, or the Export Administration Regulation (EAR), 15 CFR Parts 730-774, which controls dual use items. Offerors must disclose any proposed use of foreign nationals (FNs), their country(ies) of origin, the type of visa or work permit possessed, and the statement of work (SOW) tasks intended for accomplishment by the FN(s) in accordance with section 3.5 of the Announcement. Offerors are advised foreign nationals proposed to perform on this topic may be restricted due to the technical data under US Export Control Laws.

OBJECTIVE: The Naval (Navy and Marine Corps) Enterprise is interested in all facets of training and education to improved mission warfighter readiness and lethality. Driven by ubiquitous computing and advanced analytics techniques, the commercial applications for Manpower (e.g., human resources) and education communities have grown. The Navy seeks to apply those successes to military relevant applications across the Naval (Navy and Marine Corps) Manpower, Personnel, Training and Education (MPT&E) Enterprise. The broad topic will include various training and measurement technologies (e.g., game–based training, augmented and virtual reality domains) and the science of learning (e.g., cognitive models) to provide individual and collective training, along the training continuum (e.g., schoolhouse and to the fleet).

DESCRIPTION: We are seeking innovative solutions of technologies to support and facilitate training objectives with a low cost and small footprint. Submit no more than one proposal per topic to one of the following Focus Areas:

1 - Instruments for assessing readiness in schoolhouse and operating forces
2 - Rapid and actionable After Action Reviews (AAR) technologies and methodologies
3 - Secure training architecture for LVC Training in a Degraded and Denied Environment (D2E)
4 - Distributed secure wireless network for shipboard training in a LVC environment
5 - Shared, sensed, distributed undersea and atmospheric simulation environment for use in maritime LVC training at sea
6 - Simulation into the cockpit of live aircraft
7 - Design Guidelines / Models for training system fidelity
8 - Game-based training systems for individual and collective skills
9 - Mixed reality AR/VR adaptive scaffolding tools for enhancing readiness

1. Instruments for assessing readiness in schoolhouse and operating forces:

The Fleet needs hardware and software to capture warfighters warfare performance starting from the accession through the advanced training pipeline. The Navy lacks an end-to-end (E2E) solution to collect, fuse, analyze, and present this type of data across the whole training spectrum. In order to collect and analyze the warfighter performance this solution must be scalable and nimble to accept, tag, and fuse various data sources and types (e.g., live, virtual) until a Fleet wide data standard is accepted and implemented. The solution should be able to track a Sailor or Marine throughout his or her career whether at training commands, deployed overseas, CONUS, or at sea. Additionally, these assessments must be able to be combined into team/crew/unit/Strike Group level warfighting performance and warfare readiness. This will allow for comparison within Strike Groups at various levels (individual, team, crew) and across Strike Groups throughout the training pipeline.

2. Rapid and actionable After Action Reviews (AAR) technologies and methodologies:

The Fleet needs a standardized AAR solution across domains (e.g., surface, aviation) that will provide near real-time feedback to warfighters at the appropriate level of detail focused on mission tasks in training, assessment, or certification event(s). This feedback should be provided at the individual, unit, and strike group level. Near real-time is defined as one to two hours after the conclusion of the individual and unit level evolution(s) and eight to twelve hours for complex multi-unit, cross platform, multi-mission at sea events. Moreover, this solution should also focus on providing instructors with real-time assessment tools to enable rapid synthesis/aggregation of instructor learning points to support the near real-time requirement. This solution needs to seamlessly operate in a shipboard, aircraft, and submarine combat system(s) with the capability to be backhauled from sea to shore-based training facilities. The solution should also address current shortfalls in data availability and integration (e.g., chat, voice, radar) for assessing performance real time and post hoc.

3. Secure training architecture for LVC Training in a Degraded and Denied Environment (D2E):

The Fleet needs the ability to execute large at sea exercises to train, assess, and certify units and large collections of ships and aircraft while operating in a simulated Command and Control in a Degraded and Denied Environment (C2D2E). In order to execute this live, virtual, and constructive (LVC) at sea exercise two-way communications must be maintained for the simulation and mentors/assessors data between the simulation center ashore and the ships and aircraft at sea. This should address using existing Navy Communication Circuits but should use intelligent agents to optimize and prioritize the simulation and mentor/assessor data flow from ships and aircraft at sea and the shore.

4. Distributed secure wireless network for shipboard training in a LVC environment:

The Fleet needs the ability to train, assess, and certify Sailors onboard ships while underway using commercial AR headsets without being hardwired to a network or computer. In order to use commercial AR headsets, it requires a wireless connection to the simulation for locating the wearer of the AR headset. This should address connecting wireless headsets to a classified simulation network onboard a ship while operating at sea. The solution(s) should be able to connect inside the confines of the ship, as well as outside the skin of the ship, and between the confines of the ship and outside the skin of the ship.

5. Shared, sensed, distributed undersea and atmospheric simulation environment for use in maritime LVC training at sea:

The Fleet needs the ability to train, assess, and certify ships and aircraft in cross platform warfare against submarines and anti-ship missiles in a shared environment either under water or above the water. Currently each platform uses separate environmental data bases and target parameters which causes mismatches in various areas (e.g., ranges, detection parameters, aspect presentation, etc.). This leads to not being able to share targeting data across platforms and "negative training". The solution(s) should be able to share usable target data (e.g., range, speed, target aspect, tracking frequencies, etc.) to allow platforms to share targeting data for under water threats and above water threats from a shared environment.

6. Simulation into the cockpit of live aircraft:

The Fleet needs the ability to train, assess, and certify the aircraft carrier and amphibious assault ship along with its embarked aircraft. Currently aircraft train, assess, and certify before they embarked at instrumented land ranges without the supporting aircraft carrier or amphibious assault ship. The solution(s) should be able to inject threats with all the required data to appear as live threats in the cockpit of the aircraft, and the aircraft carrier or amphibious assault ship should have the same shared scenario as the aircraft. Additionally, the solution(s) must use existing operational/tactical circuits and must not overload these circuits.

7. Design Guidelines / Models for training system fidelity:

The Navy needs evidence-based tools and models for training system fidelity, current simulations and simulators are developed in an ad hoc manner and are costly. The solution for training developers is scientifically validated methods and tools to understand and select the optimum level of fidelity for training simulators and simulation systems. Models/tools are needed to understand the differing effects of fidelity on learning, taking into consideration trainee experience level of fidelity and task complexity, and how these factors interact to produce different learning outcomes.

8. Game-based training systems for individual and collective skills:

The Navy and Marine Corp need methods and tools to train small unit commanders to develop tactics and strategies in a dynamic and uncertain battle space. The solution is the use of multiplayer action video games designed to teach unit commanders and their team members to develop tactics and strategies on the fly. Action video games have in numerous studies demonstrated that playing multiplayer games is associated with increased cognitive performance, such as increased problem solving and decision making. These multiplayer games must have the capability to author new scenarios that reflect actual mission requirements and the ability to collect performance metrics at both individual and unit levels.

9. Mixed reality AR/VR adaptive scaffolding tools for enhancing readiness:

The Navy seeks an AR/MR- enabled Head Mounted job performance aid (JPA) to support maintenance and operations. Develop and validate a mixed reality tool for extraction and preservation of expert domain knowledge. Develop and validate JPA for transferring domain knowledge and supporting skilled acquisition for classroom and ship-based training and job support. This solution will require a pedagogical framework and design guidelines.

PHASE I: NOTE: Please add the Focus Area number you are proposing as a prefix to the Phase I Proposal title.

Validate the product-market fit between the proposed solution and Navy stakeholder and define a clear plan for trial and/or test with the proposed solution and the focus area. The proposed solution should directly address:
1. Identify the Navy end user(s) and explore the benefit area(s) which are to be addressed by the proposed solution(s)
2. Define clear objectives and measurable results for the proposed solution(s) – specifically how the proposed solution(s) will impact the end user

3. Describe the cost and feasibility of integration with current mission-specific products
4. Describe how the proposed solution(s) can be used by other government customers, both DoD and non-DoD
5. Describe technology related development that is required to successfully field the proposed solution(s)

The funds obligated on any resulting Phase I SBIR contract are to be used for the sole purpose of conducting a thorough feasibility study using scientific experiments, laboratory studies, and commercial research. Prototypes may be used or developed with SBIR funds during Phase I to better address the risks and potential return on innovative technologies.

PHASE II: Develop, integrate, and demonstrate a prototype determined to be the most feasible solution during the Phase I period. The demonstration should focus on:

1. Evaluating the proposed solution against the objectives and measurable results as defined in Phase I
2. Describing in detail how the solution can be scaled to be adopted widely
3. A clear transition path for the proposed solution that takes into account input from stakeholders
4. Specific details on how the proposed solution can be integrated and how it will be supported/sustained

PHASE III DUAL USE APPLICATIONS: Expand mission capability to a broad range of government and civilian users and applications. Coordinate with the government for additional research and development, or direct procurement of products and/or services developed in coordination with the Navy.

REFERENCES:
1. A Design for Maintaining Maritime Superiority Version 2.0 DTD December 2018. https://www.navy.mil/navydata/people/cno/Richardson/Resource/Design_2.0.pdf

2. Surface Force Strategy and Implementation of Distributed Lethality. https://www.navy.mil/strategic/SurfaceForceStrategy-ReturntoSeaControl.pdf

3. Information on Business Accelerator Pilot opportunity with H4XLabs for N193-A03 Phase I Awardees (defined in Business Accelerator Services section in Proposal Submission Instructions for Technology Acceleration Topics). https://www.h4xlabs.com/sbir

KEYWORDS: Training; AR/VR; LVC Environment; Command and Control; Models for Training; Shipboard

Questions may also be submitted through DOD SBIR/STTR SITIS website.

Standard Topics – N193-138 to N193-149

N193-138 TITLE: Lightweight Run-flat Tire/Wheel Assemblies for Marine Corps Wheeled Vehicles

TECHNOLOGY AREA(S): Ground/Sea Vehicles

ACQUISITION PROGRAM: PEO LS, Amphibious Combat Vehicle (ACV)

OBJECTIVE: Develop lightweight run-flat tire/wheel assemblies for Marine Corps Wheeled Vehicles by using innovative materials, design, manufacturing processes, and test methodology to provide increased survivability and mobility on/off paved roads and in water.

DESCRIPTION: A run-flat tire is a pneumatic tire designed to resist the effects of deflation when punctured, and to enable the vehicle to continue to be driven at reduced speeds for limited distances. Military run-flat tires have

traditionally used an insert installed in the pneumatic tire that can support the weight of the vehicle in the event of a loss of pressure. These inserts are heavy and add significant un-sprung, rotating mass that reduce ride quality and decrease vehicle fuel efficiency. Run-flats function by providing a minimal rolling radius, thus ensuring adequate traction and acceptable longevity over a specified maximum speed and range of operations. Run-flats provide immediate mobility following a flat but are designed to be used in emergency situations as their use results in the degradation of the tire.

The Marine Corps needs lightweight run-flat tire/wheel designs for military vehicles that increase the survivability and mobility of tactical and combat vehicles. The designs can use the existing or a modified Central Tire Inflation System (CTIS) and should consider the effects on the drivetrain of running tires of different diameters. The wheel assembly of interest has a 53-inch diameter using a 16 R 20 tire. The run-flat must maintain a minimum distance of 17 inches from the ground to the center of the wheel under individual wheel loads up to 11,500 lbs. The objective weight for the lightweight run-flat is less than 50 pounds but must be lighter than 75 pounds. The cost for a lightweight run-flat should be less than $2,000 per tire for a 75-pound design but could be higher for lighter weight designs. The run-flat must allow the vehicle to maintain mobility for 25 miles at a speed of 30 mph when one or two tires are flat, and 5 miles at a speed of 5 mph when three or four are flat on one side. The design must meet the requirements of SAE J2014 [Ref 1].

PHASE I: Develop concepts for lightweight run-flat tire/wheel designs that increase the survivability and mobility of the Amphibious Combat Vehicle (ACV) by exploring the use of alternative materials, design, maintainability, and manufacturing techniques that meet the requirements outlined above. Demonstrate the feasibility of the concept in meeting the Marine Corps needs. Establish feasibility by material testing and analytical modeling, as appropriate. Provide a Phase II plan that includes designs for tactical vehicles and identifies performance goals, key technical milestones, and addresses technical risks.

PHASE II: Build prototypes for material testing and analytical modeling as appropriate. Support evaluation of the prototypes to determine if the performance goals defined in the Phase II development plan and the requirements outlined in SAE J2014 [Ref 1] and TOP 02-2-698 [Ref 2] have been met.

Demonstrate system performance through prototype evaluation and modeling to include Mission Profile Run Flat, Paved Run Flat, Tire Traction, Vehicle Evasive Maneuver, Bead Unseating, Rolling Resistance, Dimensional Criteria, and Mechanical Reliability (Off-road Durability). Refine the designs based on the results of testing/modeling. Prepare a Phase III plan to transition the technology to the Marine Corps and the commercial marketplace.

PHASE III DUAL USE APPLICATIONS: Conduct full-scale application, testing, demonstration, implementation, and commercialization.

The technologies developed under this SBIR would have direct application to other Department of Defense applications including other services' Run Flat Tire/Wheel Assemblies on Combat and Tactical Wheeled Vehicles. Additional applications would include government and private security industries for personal protection, the banking industry, and police armored vehicles.

REFERENCES:
1. SAE J2014 - Pneumatic Tire/Wheel/Run flat Assembly Qualifications for Military Tactical Wheeled Vehicles. https://www.sae.org/standards/content/j2014_201303/

2. Test Operations Procedure (TOP 02-2-698) – Run flat Testing. https://apps.dtic.mil/dtic/tr/fulltext/u2/a622562.pdf

KEYWORDS: Run-flat; Run-flat Wheel Assembly; Tires; Wheels; Mobility; Survivability

Questions may also be submitted through DOD SBIR/STTR SITIS website.

N193-139 TITLE: Low Power, Portable (Podable) Rapid Processing of High Sample-Rate In-Phase Quadrature (IQ) Data

TECHNOLOGY AREA(S): Air Platform, Electronics, Ground/Sea Vehicles

ACQUISITION PROGRAM: NAE Chief Technology Office

The technology within this topic is restricted under the International Traffic in Arms Regulation (ITAR), 22 CFR Parts 120-130, which controls the export and import of defense-related material and services, including export of sensitive technical data, or the Export Administration Regulation (EAR), 15 CFR Parts 730-774, which controls dual use items. Offerors must disclose any proposed use of foreign nationals (FNs), their country(ies) of origin, the type of visa or work permit possessed, and the statement of work (SOW) tasks intended for accomplishment by the FN(s) in accordance with section 3.5 of the Announcement. Offerors are advised foreign nationals proposed to perform on this topic may be restricted due to the technical data under US Export Control Laws.

OBJECTIVE: Develop an open architecture, portable, podable, relatively low size, weight, and power (SWaP) reprogrammable solution to focus computing power on high-speed streaming data in order to rapidly extract and identify signals of interest.

DESCRIPTION: Electronic receiver bandwidth and fidelity capabilities are increasing rapidly. Each of these attributes increases file size of stored radio frequency (RF) sample data and data rates streaming to those sensors. In most cases, the data is packaged into summary descriptor format (such as pulse descriptor words (PDWs)) for further ingest by on-board computing resources or stored for off-board processing. Turning the In-Phase Quadrature (IQ) data into PDWs leaves the potential for unprocessed and unexploited data of which the end user is unaware. Reference 3 explains the current method of forming PDWs and the type of information they contain. There is no common standard for PDWs as each vendor uses their own signal detection, classification, and PDW generator algorithm. Select a PDW format that best suits the development of the approach to signal identification.

A method for collecting and exploiting the unprocessed and unexploited data that needs to be developed. Develop a capability whereby an operator can selectively filter unexploited data real-time in frequency, time, or other method. The ability to look for correlation with existing emitter files and/or to identify emitters of interest in an electromagnetic (EM)-dense environment frequency band at the point of actual IQ data, before the PDW summary information is formed which can potentially result in loss of information is needed.

For this SBIR topic, the term “emitters of interest” can be communication signals in a population-dense urban environment, such as individual cell phones, radio, television, or satellite communication. The general idea of this system is the ability to detect a specific signal, like a military type emitter, in an EM-cluttered urban environment—taking into account that the emitter of interest will be using benign signals to hide its intent or actions.

The system must take advantage of the many Open Systems Architectures (OSAs) that are available so that as threat systems advance, the system can be reprogrammable with new algorithm improvements to respond to ever changing threats. Examples include OSAs such as Open System Architecture (OSA), Sensor Open System Architecture (SOSA), and/or Modular Open System Architecture (MOSA).

The resulting system should be able to analyze 1GHz - 4GHz of instantaneous bandwidth and cover as much frequency as possible, 0.1 – 18 GHz preferred, more if possible.

The final design should be compatible with standard Air Transport Radio (ATR) chassis or equivalent chassis with SWaP requirements of fitting in a 7-10 inch diameter pod such as the ALQ-167, convert 400Hz to 28V DC, and use 350 Watts or less power. Operational system will have access to 3 PHASE 400 Hz 115/200VAC at 10A per PHASE.

Work produced in Phase II may become classified.
Note: The prospective contractor(s) must be U.S. owned and operated with no foreign influence as defined by DoD

5220.22-M, National Industrial Security Program Operating Manual, unless acceptable mitigating procedures can and have been implemented and approved by the Defense Security Service (DSS). The selected contractor and/or subcontractor must be able to acquire and maintain a secret level facility and Personnel Security Clearances. This will allow contractor personnel to perform on advanced phases of this project as set forth by DSS and NAVAIR in order to gain access to classified information pertaining to the national defense of the United States and its allies; this will be an inherent requirement. The selected company will be required to safeguard classified material IAW DoD 5220.22-M during the advanced phases of this contract.

PHASE I: Propose a new Electronic Warfare receiver architecture where such a system could reside, how it could access data, how it could be steered or reprogrammed, and what the capabilities of rapidly inferring RF environment from raw data samples are (e.g., latency, fidelity). The proposed should understand that there is a high probability of there being multiple signals within the frequency range of interest. Feedback from the PDW formation process is an option to aid in deinterleaving, but the proposed approach should rely on the predetermined mission data files that specify emitter parameters as a final option. System must have a way of dealing with the possibility that an emitter-mission data file is not loaded and providing the user with an acceptable solution. The Phase I effort will include prototype plans to be developed under Phase II.

PHASE II: Prototype a solution with (for example) GUI interaction for reprogramming of a high bandwidth data stream. Simulate the data stream or provide by other efforts - such that Phase II does not become an activity of designing a high-speed receiver. The prototype should instead focus on aiding interpretation of the data.

Work in Phase II may become classified. Please see note in Description paragraph.

PHASE III DUAL USE APPLICATIONS: Perform final testing with a real-world EM dense environment to test the developed algorithms. Demonstrate the ability to identify complex emitters. Transition and integrate into appropriate platforms and systems. Successful technology development would benefit Commercial Airport Monitoring, as well as Frequency monitoring for the communication industry.

REFERENCES:
1. “AN/ALQ-167 - E/F Band Jammer Group.” Rodale Electronics, Inc. http://www.rodaleelectronics.com/wp-content/uploads/Rodale_ALQ-167_EF_Band.pdf

2. MIL-STD-810H, DEPARTMENT OF DEFENSE TEST METHOD STANDARD: ENVIRONMENTAL ENGINEERING CONSIDERATIONS AND LABORATORY TESTS (31-JAN-2019). http://everyspec.com/MIL-STD/MIL-STD-0800-0899/MIL-STD-810H_55998/

3. MIL-STD-461, MILITARY STANDARD: ELECTROMAGNETIC INTERFERENCE CHARACTERISTICS REQUIREMENTS FOR EQUIPMENT (31 JUL 1967). http://everyspec.com/MIL-STD/MIL-STD-0300-0499/MIL-STD-461_8678/

KEYWORDS: Field Programmable Gate Array; FPGA; Radio Frequency System on Chip; RFSOC; VME International Trade Association; VITA; Graphic Processing Unit; GPU; Machine Learning; ML; Open System Architecture; OSA; Sensor Open Systems Architecture; SOSA; Modular Open System Architecture; MOSA; Artificial Intelligence; AI

Questions may also be submitted through DOD SBIR/STTR SITIS website.

N193-140 TITLE: Quantum Information Transported Over Radio Frequency

TECHNOLOGY AREA(S): Information Systems

ACQUISITION PROGRAM: NAE CTO Office

The technology within this topic is restricted under the International Traffic in Arms Regulation (ITAR), 22 CFR Parts 120-130, which controls the export and import of defense-related material and services, including export of sensitive technical data, or the Export Administration Regulation (EAR), 15 CFR Parts 730-774, which controls dual use items. Offerors must disclose any proposed use of foreign nationals (FNs), their country(ies) of origin, the type of visa or work permit possessed, and the statement of work (SOW) tasks intended for accomplishment by the FN(s) in accordance with section 3.5 of the Announcement. Offerors are advised foreign nationals proposed to perform on this topic may be restricted due to the technical data under US Export Control Laws.

OBJECTIVE: Investigate, design, and develop the capability to leverage quantum information such as electron momentum/spin to transmit information over radio frequency (RF) in binary form instead of waveform and power levels, therefore making the signal less susceptible to jamming, interception, and possibly detection.

DESCRIPTION: The Navy seeks the means to: (1) create a bias in order to transmit quantum information over radio frequency (RF) (for example, using electron spin) in a binary method as opposed to power levels and waveform modulations; (2) properly detect the quantum information (e.g., electron spin) and convert it into a binary digit (bit); and (3) by using the electron spin as the example of quantum information, designating the spin up to a 1 and a spin down to a 0, leverage this to become a transfer of information via radio frequencies.

The electron has a magnetic momentum or spin either as “up” or “down.” The usual probability of the electron having either of these spins when measured is 50%. Developing the ability to deliberately bias that spin either in the up or down would change the probability to something higher than 50% to indicate the meaning of a binary digit. The Stern-Gerlach experiment involves sending a beam of particles through an inhomogeneous magnetic field and observing their deflection. The results show that particles possess an intrinsic angular momentum that is closely analogous to the angular momentum of a classically spinning object, but that takes only certain quantized values [Ref 3].

The device must weigh less than 100 pounds and have a volume less than 3,600 cubic inches. Design goal is to be comparable to existing military avionics equipment such as an AN/ARC-210 radio [Ref 4]. Measure and characterize the behavior of the device over RF frequencies from 300MHz up to 40GHz in the following bands: 30-300MHz, 300MHz-3GHz, 1-2 GHz, 2-4GHz, 4-8 GHz, 8-12 GHz, 12-18 GHz, 18-26 GHz, and 26-50 GHz. The device should run on 28V DC and be designed with considerations of MIL-STD-810H [Ref 5]. Conduct demonstration in an indoor lab or outdoor range to demonstrate quantum information transmission and reception. Report the results including the design architecture, the measured results of quantum information detection, the detections versus frequency, and conclusion and recommendations of the test and demonstrations conducted.

Demonstrate the device on a manned fixed wing or manned rotorcraft civilian or military air vehicle, to show the overall capability that was developed.

Work produced in Phase II may become classified. Note: The prospective contractor(s) must be U.S. owned and operated with no foreign influence as defined by DoD 5220.22-M, National Industrial Security Program Operating Manual, unless acceptable mitigating procedures can and have been implemented and approved by the Defense Security Service (DSS). The selected contractor and/or subcontractor must be able to acquire and maintain a secret level facility and Personnel Security Clearances, in order to perform on advanced phases of this project as set forth by DSS and NAVAIR I order to gain access to classified information pertaining to the national defense of the United States and its allies; this will be an inherent requirement. The selected company will be required to safeguard classified material IAW DoD 5220.22-M during the advanced phases of this contract.

PHASE I: Design, demonstrate and validate, through analysis and/or simulation, a binary quantum state that can be created, transported over RF and detected by the prototyped device. Characterize the hardware it would take to make that happen. Determine the desired probability of quantum information detection given a finite number of biased quantum particles. Assess the device performance parameters including the size, weight, cooling, and power consumption of the hardware to create such a device. Estimate the parameters of feasibility for such a device to operate such as frequency range, effective radiated power of transmitted radio frequency signal, and minimal

detectable signal for reception of the RF to achieve the desired probability of quantum information detection. Predict operational environment of such a device in terms of isolation, temperature, and physical stability of device to generate the quantum information suitable for transportation over radio frequency. Determine if free-space RF is suitable for the transfer of quantum information, and propose the best-suited frequencies for such transfer. The Phase I effort will include prototype plans to be developed under Phase II.

PHASE II: Based on Phase I, design and fabricate the prototype and demonstrate/validate the ability to transport quantum information for maritime airborne applications. Measure operating parameters related to operation range, including the signal-to-noise ratio for a minimal detectable signal of the RF to achieve the desired probability of quantum information detection, and the probability of quantum binary digit detection. Demonstrate or predict how other natural phenomena such as atmospheric affects (e.g., clouds, water vapor) would affect the minimal discernable reception. Measure and/or calculate the distance to achieve a desired probability of quantum information detection. Characterize the behavior over RF frequencies from 300MHz up to 40 GHz in minimum of bands from 30-300MHz, 300-3GHz, 1-2 GHz, 2-4 GHz, 4-8 GHz, 8-12 GHz, 12-18 GHz, 18-26 GHz, and 26-50 GHz. Conduct demonstration in an indoor lab or outdoor range to demonstrate quantum information transmission and reception. Report the results including the design architecture, the measured results of quantum information detection, the detections versus frequency, and conclusions and recommendations of the tests and demonstrations conducted.

Upon successful demonstration in the lab or outdoor range, build a flight-worthy system to transmit and detect quantum information that can fly aboard a manned civilian or military air vehicle.

Work in Phase II may become classified. Please see note in Description section.

PHASE III DUAL USE APPLICATIONS: Based on Phase II prototype, prepare for and demonstrate the capabilities in a relevant airborne environment such as a manned fixed-wing or manned rotary-wing civilian or military aircraft. Collect and verify the performance parameters to include bit rate, error rates, and data transport rates in megabits per second. Develop a draft, system performance specification. Report on produce-ability of product, as well as suitability of product to augment existing radio-frequency systems. Propose options for integrating product into existing military radio frequency systems. Transition final device for use on appropriate platforms.

This technology can apply to any transport of information that currently uses radio frequencies including household Wi-Fi routers, mobile communications, security and encryption applications, broadcast communications, and other microwave data transmissions.

REFERENCES:
1. Drysdale, T. D., Allen, B., Cano, E., Bai, Q. and Tennant, A., "Evaluation of OAM-radio mode detection using the phase gradient method." 2017 11th European Conference on Antennas and Propagation (EUCAP), Paris, 2017, pp. 3606-3610. https://doi.org/10.23919/EuCAP.2017.7928341

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KEYWORDS: Quantum; Data Transport; Information Science; Datalink; Radio Frequency; Assured Command and Control

Questions may also be submitted through DOD SBIR/STTR SITIS website.

N193-141 TITLE: Resilient Autonomous Subsystems for Unmanned Air Systems (UAS)

TECHNOLOGY AREA(S): Battlespace, Information Systems

ACQUISITION PROGRAM: NAE Chief Technology Office

The technology within this topic is restricted under the International Traffic in Arms Regulation (ITAR), 22 CFR Parts 120-130, which controls the export and import of defense-related material and services, including export of sensitive technical data, or the Export Administration Regulation (EAR), 15 CFR Parts 730-774, which controls dual use items. Offerors must disclose any proposed use of foreign nationals (FNs), their country(ies) of origin, the type of visa or work permit possessed, and the statement of work (SOW) tasks intended for accomplishment by the FN(s) in accordance with section 3.5 of the Announcement. Offerors are advised foreign nationals proposed to perform on this topic may be restricted due to the technical data under US Export Control Laws.

OBJECTIVE: Develop autonomous capabilities that allow teams of unmanned air systems (UAS) to make decisions independently that satisfy operator-provided mission objectives in complex, uncertain, denied environments.

DESCRIPTION: The U.S. Navy increasingly relies upon UAS to perform a variety of missions. Current UAS require continual operator supervision, relying on operators to devise a course of action in response to unexpected changes in the operating environment. The dependence upon operator-provided decisions during a mission reduces mission effectiveness by introducing a dependency on high quality service communications between the operator and UAS, demanding an undesirably high operator-to-vehicle ratio for swarming techniques; and additionally, introducing latencies between UAS sensor observations and UAS reactions. To improve UAS performance, NAVAIR is developing Research & Autonomy Innovation Development Environment & Repository (RAIDER), a re-usable software infrastructure utilizing the Future Airborne Capability Environment (FACE) standard [Ref 2]. RAIDER is a reusable software infrastructure derived from the Defense Advanced Research Projects Agency (DARPA) Collaborative Operations in Denied Environments (CODE) program that enables teams of UAS to make decisions autonomously in denied environments [Ref 1].

NAVAIR has a requirement to expand RAIDER to support diverse Navy-relevant missions. This SBIR topic seeks to enable RAIDER expansion by having the performer produce FACE compliant units of portability (UOPs) and behaviors that provide UAS with resilient autonomous behaviors and planning services. These products should focus on adding functionality to accomplish new Strike, anti-surface warfare (ASW), or anti-submarine warfare (ASuW) missions. The performer's UOPs should promote operational resilience, and must be capable of managing unexpected circumstances (including unexpected threats and unexpected adversary/non-combatant maneuvers) as well as losses of capability due to UAS damage, unexpected system/subsystem failures, and attrition. RAIDER will be available to the performing small businesses.

RAIDER UAS UOPs must be capable of satisfying operator-provided objectives and rules of engagement by generating tactical decisions without further operator involvement (e.g., search for and track all vessels in a given area, never approach within 10 miles of a vessel). UOPs must utilize a principled approach to assure that UAS decisions are appropriate, and made in real time. Operational resilience should be demonstrated by showing that the on-board planning with the UOPs is capable of:
- Providing effective UAS coordination with varying degrees of complexity. UOPs should be capable of coordinating teams of as few as two and as many as thirty UAS to respond to maneuvers and threats from as many as fifty adversaries.
- Operating in denied environments in which communications are limited and full connectivity between UAS may

not exist for periods of an engagement.
- Guaranteeing that a priori operator-provided rules of engagement are not violated. Rules of engagement may include geospatial, temporal, and behavioral constraints.
- Supporting coordination between heterogeneous teams in which UAS may include different payloads, communications transceivers, and mobility characteristics.

Develop a UAS capability to quickly and accurately geo-locate and identify stationary emitters within a region by only using passive RF sensors with limited communications between the unmanned air vehicles (UAVs) within a UAS. A collaborative autonomous fusion UOP to generate a nearly common operational picture (NCOP) amongst a group of UAS is needed. The UOP should address constraints on communication between UAS, i.e., a reduced subset of information can be shared. Information includes own-ship telemetry and sensor measurements or tracks, or a combination of the two. Each UAS must be able to determine constraints on sharing information with other UAS in the distributed autonomous systems to support mission success. Such intelligent information sharing must consider the mission(s) objectives, time constraints, bandwidth constraints, mission constraints, and the information required to support the mission objectives.

Work produced in Phase II may become classified. Note: The prospective contractor(s) must be U.S. owned and operated with no foreign influence as defined by DoD 5220.22-M, National Industrial Security Program Operating Manual, unless acceptable mitigating procedures can and have been implemented and approved by the Defense Security Service (DSS). The selected contractor and/or subcontractor must be able to acquire and maintain a secret level facility and Personnel Security Clearances, in order to perform on advanced phases of this project as set forth by DSS and NAVAIR in order to gain access to classified information pertaining to the national defense of the United States and its allies; this will be an inherent requirement. The selected company will be required to safeguard classified material IAW DoD 5220.22-M during the advanced phases of this contract.

PHASE I: Develop one or more autonomous UOPs that support a NAVAIR-relevant mission. Suitable missions may include, but are not limited to, Intelligence, Surveillance and Reconnaissance (ISR) and Fast Attack Craft defense. Develop and design the process that discusses the feasibility and effectiveness of addressing the passive RF geo-location UAS problem. This process should include the framework and the algorithms, tools, or UOPs used for the solution. Potential roadblocks may be encountered; identify them and approaches to overcome them. Demonstrate UOP resilience in simulation-based experiments. The Phase I effort will include prototype plans to be developed under Phase II.

PHASE II: Integrate autonomous UOPs into RAIDER-enabled UAS and conduct live flight demonstrations showing proof of concept for UOP in a collaborative autonomous mission. Note: A RAIDER-enabled UAS will be provided by the government.

Develop a UAS UOP to quickly and accurately geo-locate and identify stationary and moving emitters within a region by only using passive RF sensors and with limited communications between the unmanned air vehicles (UAVs) should be demonstrated. To find and accurately geo-locate all of the emitters quickly, the UAVs must autonomously produce a coordinated optimal search and adaptive plan as emitter data is received real-time while avoiding being attrited if the enemy radars have developed a track on that asset. Gather metrics from flight demonstration to show the completeness, accuracy, and timeliness of identifying, tracking, and localizing emitters.

Demonstrate a collaborative autonomous fusion UOP designed to address constraints on communication between UAS. Validate that the intelligent information sharing must show consideration the mission(s) objectives, time constraints, bandwidth constraints, mission constraints, and the information required to support the mission objectives. Gather metrics from demonstration to show fusion, information sharing effectiveness, communications effectiveness, and ability to thrive and complete desired mission in denied communications and denied GPS environments. Demonstrate algorithms on operationally realistic simulated scenarios and modify/extend as necessary to address any challenges that arise during development and testing.

Work in Phase II may become classified. Please see note in Description section.

PHASE III DUAL USE APPLICATIONS: Conduct fleet demonstrations, and participate in discrete and extended fleet experiments to validate new capability. Commercial applications from a successfully developed technology would include forest fire management by the Dept. of the Interior. Equipped UAS and unmanned ground vehicles (UGVs) would be able to work together to fight forest fires in large swarms of firefighting water "tankers".

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KEYWORDS: Autonomous Systems; Artificial Intelligence; Unmanned Air Systems; UAS; Sensor Fusion; Denied Environment; Communications

Questions may also be submitted through DOD SBIR/STTR SITIS website.

N193-142 TITLE: Electrically Small Antenna/Sensor for Low Frequency Detection/Direction Finding

TECHNOLOGY AREA(S): Air Platform, Electronics, Ground/Sea Vehicles

ACQUISITION PROGRAM: NAE Chief Technology Office

The technology within this topic is restricted under the International Traffic in Arms Regulation (ITAR), 22 CFR Parts 120-130, which controls the export and import of defense-related material and services, including export of sensitive technical data, or the Export Administration Regulation (EAR), 15 CFR Parts 730-774, which controls dual use items. Offerors must disclose any proposed use of foreign nationals (FNs), their country(ies) of origin, the type of visa or work permit possessed, and the statement of work (SOW) tasks intended for accomplishment by the FN(s) in accordance with section 3.5 of the Announcement. Offerors are advised foreign nationals proposed to perform on this topic may be restricted due to the technical data under US Export Control Laws.

OBJECTIVE: Develop an antenna/sensor package that provides high frequency/very high frequency (HF/VHF) detection and direction finding (DF) capabilities in a 7-inch diameter, flight vehicle cavity.

DESCRIPTION: Achieving high-bandwidth antennas in HF/VHF for transmitters and receivers is a difficult radio frequency (RF) design. References 3 and 4 illustrate that as antennas become significantly smaller relative to the wavelength of the signal, the instantaneous bandwidth of the antenna sharply decreases. Traditional antennas are often at least a quarter of the wavelength of the intended signal, and in HF/VHF applications, this forces antenna to be > 1 meter in size. Therefore, traditional design approaches for high-gain and high-bandwidth antennas onboard tactical and small-unmanned aircraft are not suitable due to the antenna's physical size.

Specifically, as antennas are miniaturized relative to the signal wavelength, their impedance bandwidth sharply decreases. For transmitters, the antenna rejects and reflects high-bandwidth signals because any frequency outside of its impedance bandwidth is mismatched with the antenna, preventing efficient signal acceptance in the antenna. For receivers, the electrical size of the antenna is so small compared to wavelength, that the gain of the antenna is small, reducing signal to noise ratio (SNR) and sensitivity of the receiver. This is fundamentally due to the conductive and material losses overwhelming the radiation power of the receiver. This prevents the signal from being distinguishable above the noise floor.

References 1 and 2 illustrate a method for overcoming bandwidth-limited electrically small antenna utilizing a transistor switch that directly modulates the signal in order to “time-vary” the impedance boundary conditions of the antenna. If synchronized well, the signal at the input of the antenna is matched exactly at the same moment the impedance boundary of the antenna, due to the transistor, is changed. Yet, both of these references 1 and 2 are methods for electrically small transmitters, and not for electrically small receivers.

For receivers, achieving high-gain, high-bandwidth antennas are difficult as stated above. References 5 and 6 propose a method for using cryogenic systems that significantly reduce the antenna temperature so as the incoming SNR of the signals have significantly lower noise figure at the input of the RF front end. Still, such proposals require additional physical volume to house said-cryogenic systems, significantly increasing the physical area needed. Specifically, this topic seeks a HF/VHF antenna/sensor package capable of direction finding (DF).

Traditionally, high-gain sensor packages are comprised of arrays capable of electronic scanning. The physical size of the package directly increases with demands for higher gain. In rapidly evolving aerodynamic environments, physically large antennas are not practical for tactical aircrafts, unmanned vehicles, and weapons applications.

The proposed antenna sensor system must handle up to 10 Watts, physically sized in all three physical dimensions less than a tenth of the wavelength. The ratio of the radiated power to the total power (i.e., the sum of the radiated power, power lost to ohmic losses, and power lost to material losses) must be as high as possible but greater than 50% or must achieve an antenna gain of at least -6 dBi. The antenna radiation pattern should have a beam width of 3-5 degrees, but an omnidirectional pattern along a vertical axis is acceptable. Clearly state the necessary electronics to achieve direction finding. A 360-degree scan within 2 seconds or a 10 ms dwell time per beam (if antenna is directive) is desired.

An innovative approach to achieving these results would include:
1) Significantly reduce material losses and conduction losses so as the antenna radiation efficiency is almost 100% (0 dB).
2) Reduce the noise figure and antenna temperature so as the SNR of the signal at the input of the receiver RF front end is at least 6 dB.
3) Provide information (i.e., direction finding) on where the signal came from while handling up to 10W of power within an angular resolution of 3-5 degrees.

PHASE I: Design and determine the best low-frequency sensing approaches that are packable into a physically 7-inch diameter volume and used to sense HF/VHF signals, and provide direction-finding capability. The Phase I effort will include prototype plans to be developed under Phase II.

PHASE II: Develop and prototype a solution that can be ‘flown’ in an anechoic RF chamber setting whereas HF/VHF performance can be characterized within proposed electrically small (length, width, height less than tenth wavelength) of volume. Identify and propose solutions to areas that will be difficult to transition to high speed flight.

PHASE III DUAL USE APPLICATIONS: Finalize design and perform testing to ensure HF/VHF performance in a flight operational manner where RF performance from chamber setting is maintained in-flight. Transition final solution to appropriate platforms and end users. Successful technology development would benefit space communications, general aviation, wireless infrastructure, and the internet of things (IoT).

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KEYWORDS: Electrically Small Receiver; HF/VHF Antenna; Direction Finding; DF; Antenna; Low Profile

Questions may also be submitted through DOD SBIR/STTR SITIS website.

N193-143 TITLE: Defeating Cognitive Sensors

TECHNOLOGY AREA(S): Air Platform, Battlespace

ACQUISITION PROGRAM: CTO - AI Transformational Thrust Areas

The technology within this topic is restricted under the International Traffic in Arms Regulation (ITAR), 22 CFR Parts 120-130, which controls the export and import of defense-related material and services, including export of sensitive technical data, or the Export Administration Regulation (EAR), 15 CFR Parts 730-774, which controls dual use items. Offerors must disclose any proposed use of foreign nationals (FNs), their country(ies) of origin, the type of visa or work permit possessed, and the statement of work (SOW) tasks intended for accomplishment by the FN(s) in accordance with section 3.5 of the Announcement. Offerors are advised foreign nationals proposed to perform on this topic may be restricted due to the technical data under US Export Control Laws.

OBJECTIVE: Develop innovative and operationally efficient approaches to exploit weaknesses in an adversary's neural network-based cognitive sensing systems, and by association, techniques to protect our own systems from deception.

DESCRIPTION: The 2018 National Defense Strategy notes the challenge presented by new technologies such as big data analytics, artificial intelligence, and autonomy. Because of the lower barriers of entry, the utilization of these approaches are moving at accelerating speed. [Ref 1] These technologies are enabling the development and fielding of a class of cognitive sensing systems. A variety of neural networking approaches are being employed as the basis for the underlying machine learning. In many instantiations, these sensing systems train continuously while operational in an unsupervised fashion in an effort to gain maximum additivity to a dynamic threat environment. For example, concepts for true cognitive electronic warfare systems envision a neural network-driven sensor that "should be able enter into an environment not knowing anything about adversarial systems, understand them and even devise countermeasures rapidly". [Ref 2] Obviously as our adversaries field these systems, we will seek methods to counter them and in the same vein as we develop the very adaptive systems, we must understand their vulnerabilities and take steps to mitigate threats. It has been shown that neural network-based classifiers can be fooled by subtle undetected adversarial training leading to sensor responses that are inappropriate or incorrect. These vulnerabilities are widely recognized and the research community has proposed many defenses that attempt to detect and defend the network from adversarial training. "Unfortunately, most of these defenses are not effective at classifying adversarial examples correctly." [Ref 3] We must better understand how to exploit these fundamental

blind spots in the training algorithms which adversary might utilize and how to protect our own system from such deception. Consider undetectable adversarial training techniques as well as other approaches when designing a solution.

Work produced in Phase II may become classified. Note: The prospective contractor(s) must be U.S. owned and operated with no foreign influence as defined by DoD 5220.22-M, National Industrial Security Program Operating Manual, unless acceptable mitigating procedures can and have been implemented and approved by the Defense Security Service (DSS). The selected contractor and/or subcontractor must be able to acquire and maintain a secret level facility and Personnel Security Clearances. This will allow contractor personnel to perform on advanced phases of this project as set forth by DSS and NAVAIR in order to gain access to classified information pertaining to the national defense of the United States and its allies; this will be an inherent requirement. The selected company will be required to safeguard classified material IAW DoD 5220.22-M during the advanced phases of this contract.

PHASE I: Conceptually develop robust and operationally feasible approaches to defeat emerging cognitive sensor systems by exploiting weaknesses of these high data-driven neural network approaches. Perform an unclassified proof of concept demonstration to show the scientific and technical merit of candidate approaches. Consider undetectable adversarial training techniques as well as other approaches in the design. The Phase I effort will include prototype plans to be developed under Phase II.

PHASE II: Perform detailed development and demonstrate algorithm performance in terms of ease of operational implementation, effectiveness in degrading system performance, and adaptability. Consider candidate cognitive sensor systems in electronic warfare and radar. Consider how own systems might be protected from such deception while maintaining advantages of cognitive system adaptability. Demonstrate the algorithms in high-fidelity, operationally representative scenarios. Prepare a detailed concept of operations describing the implementation of the approach in the field and potential challenges in its implementation.

Work in Phase II may become classified. Please see note in the Description.

PHASE III DUAL USE APPLICATIONS: Implement algorithmic approaches and concepts to defeat adversarial cognitive-based systems into Navy operation systems and concepts of operations. Incorporate methods to protect our own cognitive based sensors from exploitation. The same general techniques are applicable to a wide range of data-driven cognitive systems including commercial applications utilizing internet-based data mining.

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KEYWORDS: Cognitive Sensors; Radar; Electronic Warfare; Electronic Support Measures; Deception; Behavior Manipulation

Questions may also be submitted through DOD SBIR/STTR SITIS website.

N193-144 TITLE: Innovative, Affordable Testing Methodologies for Hypersonic Vehicle Material Systems

TECHNOLOGY AREA(S): Materials/Processes

ACQUISITION PROGRAM: NAE Chief Technology Office

The technology within this topic is restricted under the International Traffic in Arms Regulation (ITAR), 22 CFR Parts 120-130, which controls the export and import of defense-related material and services, including export of sensitive technical data, or the Export Administration Regulation (EAR), 15 CFR Parts 730-774, which controls dual use items. Offerors must disclose any proposed use of foreign nationals (FNs), their country(ies) of origin, the type of visa or work permit possessed, and the statement of work (SOW) tasks intended for accomplishment by the FN(s) in accordance with section 3.5 of the Announcement. Offerors are advised foreign nationals proposed to perform on this topic may be restricted due to the technical data under US Export Control Laws.

OBJECTIVE: Develop innovative, affordable thermal/mechanical test methods for hypersonic material systems under a relevant hypersonic environment in a range of Mach 5-20.

DESCRIPTION: Hypersonic vehicles and their propulsion systems have significant challenges in their design and development attributed to their extreme operational environments. One of the key challenges in hypersonic vehicles is their thermal protection materials and management systems. Recent progress in the research and application of hypersonic material systems has significantly contributed to our understanding of materials' behavioral aspects under extreme hypersonic environments. However, ever-increasing demands of hypersonic vehicles in terms of function, operation, and life expectancy require continuous technological innovations. In addition, there is a need for advanced test methodologies for hypersonic materials to ensure operational reliability and durability of hypersonic vehicles. Therefore, there is a need to develop innovative, affordable thermal/mechanical test methods under a relevant hypersonic operational environment. The target hypersonic environment ranges between Mach 5-20. The environment must recreate operational conditions including temperature, heat flux, thermal/pressure loading, atmosphere and plasma. The test methods must be able to assess thermomechanical properties of candidate hypersonic material systems with respect to strength, creep, and life coupled with relevant test frames. Subsequently, the test methods must be able to characterize environmental durability of the materials in terms of oxidation, ablation, and catalytic/plasma effects. Candidate hypersonic materials are primarily targeted for leading edge applications in which appropriate thermal management architectures (e.g., for thermal gradient or cooling, etc.), although not required, may be taken into account. Consider employing Finite Element Analysis (FEA), computational fluid dynamics (CFD), and Integrated Computational Materials Engineering (ICME) or any other physics/chemistry-based analytical tools to design optimized target test conditions in conjunction with test coupons/sub-elements and test facility. Collaborations with research institutions could strengthen the efficacy of research efforts and are thus encouraged.

Work produced in Phase II may become classified. Note: The prospective contractor(s) must be U.S. owned and operated with no foreign influence as defined by DoD 5220.22-M, National Industrial Security Program Operating Manual, unless acceptable mitigating procedures can and have been implemented and approved by the Defense Security Service (DSS). The selected contractor and/or subcontractor must be able to acquire and maintain a secret level facility and Personnel Security Clearances. This will allow contractor personnel to perform on advanced phases of this project as set forth by DSS and NAVAIR in order to gain access to classified information pertaining to the national defense of the United States and its allies; this will be an inherent requirement. The selected company will be required to safeguard classified material IAW DoD 5220.22-M during the advanced phases of this contract.

PHASE I: Design and develop initial conceptual model(s) of proposed thermal, environmental, mechanical test methods under the required hypersonic environment of Mach 5-20. Determine and demonstrate the feasibility of the designed model(s). The Phase I effort will include prototype plans to be developed under Phase II.

PHASE II: Fully develop and optimize the approach formulated in Phase I. Demonstrate and validate the approach using selected hypersonic material systems. Develop and deliver a laboratory-scale test cell prototype with thermal/environmental provisions.

Work in Phase II may become classified. Please see note in Description paragraph.

PHASE III DUAL USE APPLICATIONS: Perform final testing and transition the approach to hypersonic leading edge sub-elements to assess their related operational capabilities under simulated Mach 5-20 environments. The topic, if successful, will have both private-sector commercial potential and dual-use applications due to its unique nature of new, affordable technology development. Test Methodologies would also allow the energy sector to quantify material properties for high-temperature materials and composites, which in turn allows the validation of modeling and simulation.

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KEYWORDS: Hypersonic; Hypersonic Materials; Hypersonic Thermal Management; Hypersonic Thermal Protection Materials; Ceramics; Ceramic Matrix Composites

Questions may also be submitted through DOD SBIR/STTR SITIS website.

N193-145 TITLE: Defensive Coordinator for Autonomous Countermeasure Systems

TECHNOLOGY AREA(S): Air Platform, Battlespace, Information Systems

ACQUISITION PROGRAM: NAE Chief Technology Office

The technology within this topic is restricted under the International Traffic in Arms Regulation (ITAR), 22 CFR Parts 120-130, which controls the export and import of defense-related material and services, including export of sensitive technical data, or the Export Administration Regulation (EAR), 15 CFR Parts 730-774, which controls dual use items. Offerors must disclose any proposed use of foreign nationals (FNs), their country(ies) of origin, the type of visa or work permit possessed, and the statement of work (SOW) tasks intended for accomplishment by the FN(s) in accordance with section 3.5 of the Announcement. Offerors are advised foreign nationals proposed to perform on this topic may be restricted due to the technical data under US Export Control Laws.

OBJECTIVE: Develop novel Artificial Intelligence (AI) methods that predict future actions of an adversary using their assets, the arrangement of those assets, and the recent behaviors of those assets. In the case where adversarial action can result in a "mission kill", "hard kill", or "soft kill" of U.S. assets, develop additional AI methods to automate a countermeasure response coupled with maneuver and pattern egress from potentially lethal encounters. Additionally, ensure that precautions are in place to avoid leading an encounter into an unintended escalation. Knowledge gained from this effort could further allow the DON to counter known vulnerabilities in autonomous

capability design efforts.

DESCRIPTION: The tempo of warfare is increasing. Winning wars will require faster decision-making, which must be based on reading not only what adversaries have done, but also what future actions they are likely to undertake. Drawing inspiration from team sports where there is both offensive and defensive play (e.g., football, soccer, basketball), the defensive team must quickly and accurately read the offensive team's actions to determine how best to counter the offense's future actions. When playing defense, the coach and players need to "read" the offense and adjust their defensive posture to thwart the offensive drive. The "reading" is based on a combination of observation and learned experience. The observation is to collect data on the disposition, but the interpretation of the data is based on experience and knowledge of how the game is played.

In the case of a future conflict where Unmanned Air Systems (UAS) are sent on offensive missions, perhaps in vast numbers, we currently do not have a way to train, learn, and build up the years of experience that make a good defense. Further complicating matters, the two sides could be asymmetrical; one side could have much larger assets to bring to the conflict in terms of quantity and/or capability. In the case where a UAS is at risk from a potentially lethal engagement by one or more threat systems, the ability is needed to effectively predict a lethal outcome, automate optimal implementation of countermeasures, and egress to a standoff location or non-hostile terrain. Surviving an engagement is dependent on precise maneuvering and countermeasure response, and rarely anticipates follow-on threat activity. The technology would need to maintain situational awareness of known threats and real-time threat activity in order to optimize the countermeasure response and successfully escape the threat environment.

Develop a scope of operations that can offer reasonable balance between plausible and manageable.
- Consider how to provide stimulus to the algorithms.
- What is the novel AI algorithm? Propose a "Defensive Coordinator."
- Ideally, proposed solutions will be implemented into UAS. Consider processing power required for the algorithms.
- Propose a method and metric for quantifying success.
- What defensive options are available? Consider the range, mobility, and reach of defensive options.
- Consider the possibility of algorithms to assist with finding vulnerabilities in current DON autonomous vehicle designs.
- The objective is full automation, however showing that a human can be maintained in the loop for awareness is worth having.

Work produced in Phase II may become classified. Note: The prospective contractor(s) must be U.S. owned and operated with no foreign influence as defined by DoD 5220.22-M, National Industrial Security Program Operating Manual, unless acceptable mitigating procedures can and have been implemented and approved by the Defense Security Service (DSS). The selected contractor and/or subcontractor must be able to acquire and maintain a secret level facility and Personnel Security Clearances, in order to perform on advanced phases of this project as set forth by DSS and NAVAIR in order to gain access to classified information pertaining to the national defense of the United States and its allies; this will be an inherent requirement. The selected company will be required to safeguard classified material IAW DoD 5220.22-M during the advanced phases of this contract.

PHASE I: Develop initial bounded algorithms for a UAS-implemented "Defensive Coordinator" by modifying/using existing algorithms and demonstrating a proposed design in a representative war game context. Identify the data required and existing hardware capabilities to collect the data; define requirements to real-time collate and process the data; and identify the human machine interface necessary for a survivable maneuver, countermeasure response, and egress solution.

PHASE II: Extend the research toward more operationally realistic scenarios with consideration to directing defensive actions. Develop and refine ground-up prototype algorithms, incorporating lessons learned from the Phase I exploratory work into the design. Potentially demonstrate simulated ability of algorithms to engage countermeasures, initiate aircraft maneuvering, and perform egress routing. Employ threats that will be modelled using existing modelling and simulation software. Demonstrate algorithms in a mission simulation.

Work in Phase II may become classified. Please see note in Description.

PHASE III DUAL USE APPLICATIONS: Due to the broad nature of this topic, applications for proposed algorithms and lessons learned are wide and varied depending on the approaches defined in Phase II. As AI becomes more prevalent in the private sector, the autonomous driving industry is a commercial area that would benefit from a "defensive coordinator." More robust systems are required in autonomous civilian vehicles to both predict oncoming threats/pedestrians/traffic and execute time-critical options for life saving and collision avoidance.

REFERENCES:
1. Office of the Under Secretary of Defense for Acquisition, Technology, and Logistics (2016). Report of the Defense Science Board (DSB) Summer Study on Autonomy. https://www.hsdl.org/?view&did=794641

2. Office of the Under Secretary of Defense for Acquisition, Technology, and Logistics (2008). Report of the Joint DSB Intelligence Science Board Task Force on Integrating Sensor-Collected Intelligence. https://fas.org/irp/agency/dod/dsb/sensors.pdf

KEYWORDS: Autonomous; Artificial Intelligence; AI; Unmanned Air System; UAS; Threat Detection; Offensive Counter; Decision Making

Questions may also be submitted through DOD SBIR/STTR SITIS website.

N193-146 TITLE: Pulsed Power for High Energy Laser Applications

TECHNOLOGY AREA(S): Air Platform, Weapons

ACQUISITION PROGRAM: None or N/A NAE Chief Technology Office

The technology within this topic is restricted under the International Traffic in Arms Regulation (ITAR), 22 CFR Parts 120-130, which controls the export and import of defense-related material and services, including export of sensitive technical data, or the Export Administration Regulation (EAR), 15 CFR Parts 730-774, which controls dual use items. Offerors must disclose any proposed use of foreign nationals (FNs), their country(ies) of origin, the type of visa or work permit possessed, and the statement of work (SOW) tasks intended for accomplishment by the FN(s) in accordance with section 3.5 of the Announcement. Offerors are advised foreign nationals proposed to perform on this topic may be restricted due to the technical data under US Export Control Laws.

OBJECTIVE: Significantly reduce the size and weight, and improve the efficiency of Pulsed Power systems for High Energy Laser applications, suitable for operation as a pod-contained payload supporting operation in the next generation of tactical aircraft laser weapons.

DESCRIPTION: The U.S. Navy has been developing a flashlamp-pumped, 1.05 micrometer Nd:Glass rod laser design using multiple pump chambers. The current implementation requires a pulsed power supply capable of delivering 50,000 Joules of energy in 5 milliseconds. The current system is strictly laboratory-based, weighing over 8,000 pounds with a volume of 768 cubic feet. The laser operates in a pulsed mode with a pulse repetition frequency (PRF) of 100 Hz. Significant improvement in pulse rate, reduction in size, weight, and power (SWaP) of the pulsed power forming hardware, and improvement in overall laser efficiency are the goals of this SBIR topic.

Successful technology development should result in a demonstration of a minimum of 200,000 Joules in 5 milliseconds with a rise time of100-150 microseconds, while being suitable for packaging into a 330-gallon aircraft fuel pod. The final objective for the system weight is 1,500 pounds in a volume of 60 cubic feet. An intermediate goal is to demonstrate a minimum of 50,000 Joules per pulse (5 millisecond current or voltage pulse with 100-150 microsecond rise time) into the laser at 20 Hz in a volume of 120 cubic feet and a weight of 4,000 pounds. The

average power goal of this system should be 20 mega Watts (MW) with an intermediate goal of 1 MW. The Navy will provide appropriate laser rods and lamps as Government Furnished Equipment (GFE) during Phase II of the effort. The system must be able to operate at a pulse repetition rate of at least 10 Hz for all of the chambers. Each pump chamber must trigger independently from all of the other chambers, allowing for a short (up to 2 second) burst of pulses with variable inter-pulse spacing (1-10 milliseconds).

Although specifically targeted for implementation in future high-energy laser systems for tactical air platforms, the same technology would undoubtedly provide benefits to ground- and sea-based high-energy lasers and programs in all the services for applications such as missile defense and laser countermeasure systems. For the purposes of Phase II performance, the operational environmental conditions shall be nominally 5-35°C, with moderate shock and vibration conditions. However, the laser system design should be robust for eventual operation in deployed military systems and environments subject to MIL-STD-810.

PHASE I: Develop a conceptual design for an improved efficiency, smaller SWaP pulsed power system that meets requirements laid out in the Description. Include methodology and potential prototype performance that will demonstrate the proposed concept with the output pulse parameters as described. A sub-scale hardware demonstration is desirable. The Phase I effort will include prototype plans to be developed under Phase II.

PHASE II: Develop detailed designs based upon the Phase I with improved efficiency and smaller SWaP that meets Navy requirements. Build a prototype pulsed power system, according to this design, meeting intermediate parameters. Install the prototype system in a Navy laboratory, conduct preliminary testing, and report performance results to the Government.

PHASE III DUAL USE APPLICATIONS: Complete the SWaP reduction and ruggedization of the overall pulsed laser system for incorporation on a Naval aviation platform including electrical interfaces as required by MIL-STD-704F. Demonstrate the final system and the initial scale-up of manufacturing capabilities to deliver for a Program of Record (PoR). Transition the technology to an appropriate platform or end user. Pulsed laser systems may have applications in materials processing fields for cutting and welding. Other commercial applications for the pulsed power system include those where large amounts of energy in a short time period are required such as radar for commercial aviation and the medical field for x-ray systems.

REFERENCES:
1. Beach, F.C. and McNab, I. R. "Present and Future Naval Applications for Pulsed Power." IEEE Pulsed Power, 2005, pp. 1-7. https://doi.org/10.1109/PPC.2005.300462

2. MIL-STD-810G, DEPARTMENT OF DEFENSE TEST METHOD STANDARD: ENVIRONMENTAL ENGINEERING CONSIDERATIONS AND LABORATORY TESTS (31 OCT 2008). http://everyspec.com/MIL-STD/MIL-STD-0800-0899/MIL-STD-810G_12306/

3. MIL-STD-704F, DEPARTMENT OF DEFENSE INTERFACE STANDARD: AIRCRAFT ELECTRIC POWER CHARACTERISTICS (12 MAR 2004). http://everyspec.com/MIL-STD/MIL-STD-0700-0799/MIL-STD-704F_1083/

KEYWORDS: High-energy Laser; Pulsed Laser; Pulsed Power system; Laser Damage Effects; Directed Energy; Laser

Questions may also be submitted through DOD SBIR/STTR SITIS website.

N193-147 TITLE: Multi-Band Laser Source for Atom Interferometry

TECHNOLOGY AREA(S): Air Platform, Battlespace, Electronics

ACQUISITION PROGRAM: None or N/A NAE Chief Technology Office

OBJECTIVE: Develop a low space, weight, and power (SWaP) system fitting into a single rack unit for generating multiple laser frequencies to drive Rubidium85 (Rb85) transitions relevant to atom manipulation.

DESCRIPTION: The Navy is pursuing quantum sensing, both the development of new sensor technologies and the advancement of existing technologies. One of the challenges in this pursuit is simplifying and condensing complicated laboratory setups into a configuration that is able to be placed on a Navy platform. One such subset of quantum technologies is sensors based on Atom Interferometry. These sensors require simultaneous access to multiple atomic transitions for any given atom, which can result in complex electronic and optical setups. In particular, Rb85-based sensors require five separate, stabilized laser frequencies locked near the Rb85 D2 line [Ref 1-3] in order to drive the necessary atomic transitions. The characteristics of each of these laser outputs are listed in the specifications.

The currently employed method of accessing all necessary frequencies uses multiple independent lasers - each with separate saturated absorption locks. This method is demanding in terms of space and laser control electronics, and adds the complication of requiring multiple, independent locking mechanisms to stabilize each laser frequency and intensity. While adequate for laboratory demonstrations, this option is unrealistic for mobile sensor development. Integration onto a moving platform will require significant reduction in the number of optical components requiring active stabilization and lock down in order to maintain un-interrupted operation. Options that minimize the number of internal laser sources required to achieve the necessary output frequencies would have benefits in terms of complexity, ruggedness, and commonality of noise sources.

The optical and electronic packaging [Ref 4] should each be consolidated into a single 19”W x 19”D x 3.5”H rack with the optical rack having 5 polarization maintaining, FC/APC fiber coupled outputs. Consider the ability to actively stabilize frequency to within 10 kHz of the respective atomic transitions and intensity fluctuations below 0.1% of the output intensity; however, the saturated absorption reference does not necessarily need to be integrated into the completed package. All lasers must maintain polarization stability to within 0.01 degrees, which must be set to the fiber-coupled outputs. System must withstand the shock, vibration, pressure, temperature, humidity, electrical power conditions, etc. encountered in a system built for airborne use [Ref 4].

Locked laser bandwidth: threshold: <200 kHz, goal <100 kHz.
Laser band and power specifications are as follows:
TRANSITION 1 (F=3 to F’=4): LASER 1 – red detuned by 6-10 MHz, coherent output, threshold: 200mW CW, goal: 300mW CW; LASER 2 – On resonance, coherent output, threshold: 6 mW, goal: 10 mW CW; LASER 3 – On resonance, coherent output, threshold: 60mW CW, goal: 80mW CW.
TRANSITION 2 (F=2 to F’=3): LASER 4: red detuned by 10-15 MHz, coherent output, threshold: 40mW CW, goal: 80mW CW.
TRANSITION 3 (F=2 to F’=3): LASER 5: red detuned by 1.5 GHz, coherent output, threshold: 40mW CW, goal: 60Mw CW.

The final system should be capable of operating under the conditions specified in [Ref 4]. Additionally, weight threshold: <30 lbs, goal: <10 lbs and power threshold: <200W, goal: <50W.

PHASE I: Develop the system design, including modeling, to determine the expected power output and phase stability, and demonstrate feasibility of the proposed solution. The Phase I effort will include prototype plans to be developed under Phase II.

PHASE II: Acquire necessary optical components, including lasers, Acousto-Optic Modulators (AOMs), lenses, and any other optical and electrical components required to accomplish the design developed during Phase I. Develop, demonstrate, validate and deliver prototype based on Phase I work.

PHASE III DUAL USE APPLICATIONS: Demonstrate operation of Phase II prototype in a magneto optical trap. Ruggedize the prototype to meet MIL-STD-810G [Ref 4] operational conditions. Commercial and academic use of laser cooled Rubidium will benefit from a simpler process for generating the necessary optical frequencies leading to less expensive and more reliable systems that utilize cooled rubidium. This could benefit existing industrial uses for cooled rubidium in atomic clocks, gravitational sensors, and any other application that requires laser cooling of rubidium.

REFERENCES:
1. Phillips, W. "Laser Cooling and Trapping of Neutral Atoms." Reviews of Modern Physics, Vol. 70, No. 3, 1998; https://journals.aps.org/rmp/pdf/10.1103/RevModPhys.70.721

2. Kasevich, M. and Chu, S. “Atomic Interferometry Using Stimulated Raman Transitions.” Phys. Rev. Lett. 67, 2, pp. 181-184, 8 July 1991. https://link.aps.org/doi/10.1103/PhysRevLett.67.181

3. Steck, D. “Rubidium 85 D Line Data.” (revision 2.1.6, 20 September 2013) https://steck.us/alkalidata/rubidium85numbers.pdf

4. MIL-STD-810G, DEPARTMENT OF DEFENSE TEST METHOD STANDARD: ENVIRONMENTAL ENGINEERING CONSIDERATIONS AND LABORATORY TESTS (31 OCT 2008) (Section 514.6C-1, 514.-C7 pages C-19, C-20). http://everyspec.com/MIL-STD/MIL-STD-0800-0899/MIL-STD-810G_12306/

KEYWORDS: Laser; Atomic; Quantum; Rubidium; Multi-Band; Magneto Optic Trap; MOT

Questions may also be submitted through DOD SBIR/STTR SITIS website.

N193-148 TITLE: Unmanned Underwater Vehicle (UUV) Technology to Enable Readiness of Navy Ranges

TECHNOLOGY AREA(S): Battlespace, Electronics, Sensors

ACQUISITION PROGRAM: U.S. Navy Marine Species Monitoring program sponsored by US Fleet Forces & Commander Pac Fleet

OBJECTIVE: The Navy seeks to develop enabling technologies that can collect a broad spectrum of ocean acoustic data that allows for large scale spatial and temporal research on ambient sources of sound and biologics such as whales and dolphins.

DESCRIPTION: The Navy must train and test to enhance warfighter lethality and enable undersea dominance. In order to ensure uninterrupted training and testing, the Navy is responsible for compliance with a suite of federal environmental laws and regulations such as the National Environmental Policy Act (NEPA), the Endangered Species Act (ESA), and the Marine Mammal Protection Act (MMPA). As part of the regulatory compliance process associated with these Acts, the Navy is responsible for assessing the potential impacts from military readiness activities. The Navy is required to apply for environmental permits to conduct activities that may result in impacts to protected species regulated under environmental statutes, such as ESA or MMPA. Without permits and associated environmental compliance, the Navy risks not being able to train or test. Without training and testing, the Navy cannot be ready to meet its mission. Environmental compliance is fundamental to continued uninterrupted training and testing, and ultimately, to Navy readiness.

The Navy needs to be able to monitor sites of interest such as Navy training and testing areas to avoid further unnecessary mitigations and potential geographic restrictions that may affect readiness. Currently, the Navy uses visual survey teams on a contractor-supplied vessel to monitor the presence of marine mammals in areas of Navy

interest. The costs of this method preclude the Navy from being able to effectively monitor large geographic areas, such as the entire Southern California ocean basin south of Point Conception and out to the extent of the Economic Exclusion Zone (EEZ).

The Navy seeks to develop enabling technologies that can collect a broad spectrum of ocean acoustic data that allows for large scale spatial and temporal research on ambient sources of sound and biologics such as whales and dolphins. Passive acoustic monitoring (PAM) is a proven means of detecting, classifying, and localizing vocally active marine mammals, as well as a number of fish species. Unmanned underwater vehicles (UUVs) are the most effective platform type to cover large spatial and temporal scales, with an endurance of three months or greater. The Navy seeks the development of cost-effective PAM technologies (less than $100K) capable of sampling up to 200 kHz, deployed on UUVs capable of recording and archiving acoustic time-series data, running near real-time acoustic detectors and classifiers capable of transmitting detection reports via remote satellite link. The UUV, PAM-integrated package needs to be capable of being deployed and recovered nearshore from small vessels such as a Rigid Hull Inflatable Boat (RHIB) with a minimally staffed crew. The platform should weigh less than 115 kilograms and be less than 4.5 meters in length, not including towed cabled sensor weight or length.

The Navy is interested in increasing knowledge and understanding of all marine mammal species. However, in order to provide some guidance on research priorities, below is a list of priority marine mammal species:
-Deep diving species (Cuvier's beaked whale, other beaked whales, and other deep diving species)
-ESA-listed species (large whales)
The UUV PAM system should be capable of acoustically detecting at least one of the priority species. Systems with capabilities to detect multiple species in the low and high frequency bands are desirable.

This investment area aligns with the goals of the Navy's Task Force Ocean to make every Navy platform a sensor for data collection. Advances in sensor technologies and platforms are increasing rapidly so it is important to continually integrate these new capabilities to reduce financial or operational constraints that impact the mission. Data from this technology development has further application in oceanographic, UUV, and sensor development research within Navy. This technology would have immediate application to enable efficient and cost-effective implementation of the Navy's Marine Species Monitoring program in support of the Navy's environmental compliance and permitting processes.

Minimum specifications :
- Minimum 3-month deployment and recording endurance
- Acoustic frequency band of general interest: 10Hz-100kHz (designs may limit to specific bands within this range to target specific species)
- Design PAM to detect at least one species of primary interest and determine direction of signal detected with a minimum of 30 degree bearing resolution (designs may limit to specific bands within this range to target specific species)
- Capability to run onboard detectors and/or classifiers for acoustic signals of interest and transmit results in near-real time via iridium
- Develop guidance documentation for externally created detector and classifiers developed in MATLAB to interface UUV PAM platform
- Archive, unprocessed acoustic and environmental data onboard the system for post-recovery analysis
- Remotely operated and autonomous navigation, and near real-time position and system health monitoring
- Near real-time sampling and reporting of oceanographic data such as salinity, temperature, and depth
- Acoustic sensor/s deployment predominantly below the thermocline with a maximum depth of 3,000 meters
- Platform speed up to 2 knots, taking in consideration of minimizing flow noise over acoustic sensor/s

PHASE I: Identify existing UUV and PAM technologies capabilities that could be leveraged towards the design of a prototype. Include a cost benefit analysis and proposed recommendation of the initial design specifications for a Phase II prototype that would best address the need in a cost-effective manner. The Phase I Option, if exercised, will include the initial design specifications and capability description to build a prototype in Phase II. Develop a Phase II plan.

PHASE II: Build a full prototype and conduct an initial bench test of the sensor and platform package with the minimum specifications listed in the Description. Following the bench test, conduct at-sea deployment testing nearshore with a phased test plan to demonstrate offshore capability. At completion of testing, the sensor package must be able to demonstrate that it is capable of meeting the minimum specifications and be deployed and recovered in an efficient manner with minimal ship time and manpower. Total deployment, operation, and recovery costs should be less than $250K per mission. Additionally, package must demonstrate the ability to run onboard acoustic detectors and classifiers for marine mammal species of interest, such as those that are available on Oregon State University's Cooperative Institute for Marine Resources Studies website [Ref 5], and send reports via remote link in near real-time, along with location and other platform information.

At the end of Phase II, the awardee will prepare a Phase III development plan to transition the technology for Navy and potential commercial use.

PHASE III DUAL USE APPLICATIONS: Demonstrate the UUV, PAM package in application to a specific Navy Marine Species Monitoring program objective of acoustically monitoring a geographic area of interest. Following successful demonstration of application to a specific objective of navy interest, a transition plan will be developed to transition the technology to the Navy's Marine Species Monitoring program. This technology has commercial applications for oceanographic and marine species research by universities and other government agencies. For potential future application of the UUV PAM system in sensitive locations such as Navy ranges, the Navy will need to consider including encryption of the data to meet Federal Information Standard (FIPS) 140 Level 1-2 standards using National Institute of Standards and Technology (NIST) approved technology.

REFERENCES:
1. "The Marine Mammal Protection Act of 1972 as Amended."
https://www.fisheries.noaa.gov/national/marine-mammal-protection/marine-mammal-protection-act

2. "Endangered Species Act."
https://www.fws.gov/endangered/laws-policies/esa.html

3. "National Environmental Policy Act."
https://ceq.doe.gov/laws-regulations/laws.html

4. Office of Naval Research. "Task Force Ocean."
https://www.onr.navy.mil/task-force-ocean

5. Oregon State University, Cooperative Institute for Marine Resources Studies. "Ishmael."
http://www.bioacoustics.us/ishmael.html

KEYWORDS: Marine Mammals; Autonomous; Monitoring; Species; Detection; Classification; Localization; Sensor; Acoustic; Glider; AUV; UUV; PAM

Questions may also be submitted through DOD SBIR/STTR SITIS website.

N193-149 TITLE: Satellite Communications Antenna Pointing for Positioning (SCAPP)

TECHNOLOGY AREA(S): Information Systems

ACQUISITION PROGRAM: PEO C4I PMW/A 170, ACAT IC, Navy Multiband Terminal (NMT); ACAT III GPNTS, NoGAPSS FNC

The technology within this topic is restricted under the International Traffic in Arms Regulation (ITAR), 22 CFR Parts 120-130, which controls the export and import of defense-related material and services, including export of sensitive technical data, or the Export Administration Regulation (EAR), 15 CFR Parts 730-774, which controls dual use items. Offerors must disclose any proposed use of foreign nationals (FNs), their country(ies) of origin, the type of visa or work permit possessed, and the statement of work (SOW) tasks intended for accomplishment by the FN(s) in accordance with section 3.5 of the Announcement. Offerors are advised foreign nationals proposed to perform on this topic may be restricted due to the technical data under US Export Control Laws.

OBJECTIVE: Develop prototype algorithms for accurately providing precise angular pointing vectors from a shipboard satellite communications antenna to geostationary (GEO) communications satellites, develop positioning algorithms for the navigation system host to process the pointing vectors into positional data, and develop an Interface Control Document (ICD) describing the messaging and formats to provide this pointing information to the GPS-based Positioning Navigation and Timing Service (GPNTS) as an input message.

DESCRIPTION: The GPNTS is the Navy's next generation surface platform Positioning Navigation, and Timing (PNT) system providing modernized, robust, secure, integrated, and interoperable network-centric PNT capabilities. GPNTS will replace the legacy Navigation Sensor Systems Interface (NAVSSI) systems. The Navy Multiband Terminal (NMT) is the fourth generation Military Satellite Communications (MILSATCOM) terminal that provided both protected and wideband communications to the Fleet while enabling a fourfold increase in data rate capacity over legacy terminals. NMT will also provide MILSATCOM capability to Defense Information Systems Agency (DISA) Teleports, Ballistic Missile Defense, the Coast Guard, the United Kingdom, Canada, and the Netherlands. The NoGAPSS Future Naval Capability (FNC) will provide for integration of navigation sensors independent on GPS with new sensor fusion algorithms to process disparate sensor inputs.

This SBIR topic will address the utilization of directional data of NMT satellite antenna pointing information to derive usable positioning data as a sensor input to the GPNTS NoGAPSS functionality. This will require the development of an algorithm to process elevation and azimuth data and present an output compatible with the NoGAPSS federated navigation filter running in GPNTS. This effort includes investigating the NMT satellite communications antenna pointing scheme to yield faster tracking of GEO communications satellites (e.g., using a monopulse method in lieu of using a conical scan). This new capability will provide an independent and robust navigation input for the NoGAPSS federated filter that will reside in the GPNTS.

There is an expectation that this effort will require the development and implementation of mathematical models and formulations that will process the antenna pointing accuracy (in fractional degrees) as well as the number of satellites being pointed at, and output a description of the probable location of the ship (for example, an error ellipse for 90% probability center coordinates x and y, and major axis a with minor axis b and orientation c). The Phase II effort will include determining the antenna pointing accuracy that can be achieved at a specific technology readiness level utilizing a monopulse satellite tracking technique.

PHASE I: Formulate and determine a concept for accurate positioning using azimuth and elevation pointing vectors from two shipboard satellite communications antennas. Determine pointing accuracy and precision necessary for effective positioning (within 25% of military GPS accuracy) and study alternative pointing methods to include using the monopulse method instead of a conical scan. In addition, develop an algorithm that is capable of ingesting angles-only inputs from the SATCOM terminal and producing accurate positioning outputs (within 25% of military GPS accuracy). Positioning outputs are to be compatible with a federated filter that will be used to provide resets to the ship’s inertial navigator. Interface to GPNTS will be TIA/EIA RS-422 with “OD-19” message format. Interface to NMT will be IEEE 802.3 Ethernet. The OD-19 ICD and NMT Ethernet message format will be provided to the awardee post contract award.

Develop accurate pointing algorithms that will result in precise positioning, including consideration for ships motion and movement. Consider antenna mechanical design changes that might be necessary to accommodate precise pointing. Include performance for position accuracy of less than 1 nautical mile during periods of GPS unavailability and that is not subject to drift over time. Consider stability in shipboard environments (i.e., MIL-STD-461G, MIL-STD-810G) and vibration characteristics (MIL-STD-901D).

Formulate an innovative approach to perform positioning using only the inputs from antenna pointing vectors. Describe the most promising technical solution based on technical trade-offs performed earlier in this phase. Describe the selected pointing methodology (e.g, monopulse or other accurate and novel technique), and describe the selected navigation solution processing to produce accurate platform positioning information. Address aircraft carrier environment, motion, and vibration conditions.

Develop SBIR Phase II Project Plan to include detailed schedule, spend plan, performance objectives, and transition plan for the identified PORs.

PHASE II: Develop performance and interface specifications for SCAPP. Perform initial integration activities and identify/develop the necessary engineering changes for both the NMT and GPNTS to perform improved antenna pointing accuracy and positioning algorithms from the Phase I approach. Note: The Program Office will coordinate collaboration with the GPNTS and NMT Programs of Record (POR). It is foreseen that the positioning algorithm uses angles only. After performing initial integration activities and using the Phase I approach, develop a prototype system for demonstration and validation of the SCAPP technology. Develop strategies targeted toward systems requirements for operation in an aircraft carrier environment with specific attention paid to maintaining accurate antenna pointing to support positioning under shock and vibration conditions. Develop lifecycle support strategies and concepts for SCAPP. Develop SBIR Phase III Project Plan to include detailed schedule in Gantt format and spend plan.

PHASE III DUAL USE APPLICATIONS: Refine, fully develop, and integrate the Phase II prototype SCAPP algorithms and any antenna hardware changes into SATCOM antennas, and positioning algorithms into GPNTS. Perform Formal Qualification Tests (FQT) on the integrated NMT and GPNTS systems with final SCAPP algorithms. FQT testing will be conducted against the performance and interface specifications developed during Phase II. Support fielding of the SCAPP algorithms by implementing lifecycle support strategies and concepts with NMT and GPNTS.

Study potential commercial applications for SCAPP including implementing new pointing algorithms in antennas systems that are part of systems such as the Commercial Broadband Satellite Program (CBSP).

REFERENCES:
1. Lane, Steven O. (inventor). Satellite Antenna Pointing Systems: US Patent # 6,393,255 B1; 21 May 2002.

2. Boor, Samuel, Harvey, Melvin, Polchat, Guy et al. Single Channel Monopulse Techniques. Rome Air Development Center Technical Report # RADC-TR-67-143; 30 August 1967.

3. IEEE 802.3, Ethernet. https://en.wikipedia.org/wiki/Ethernet

4. PMW/A 170 Communications and GPS Navigation Program Office.
http://www.public.navy.mil/spawar/PEOC4I/Documents/TearSheets/PMW170_FactSheet_2017_DistroA.pdf

5. Schuler Tuning. https://en.wikipedia.org/wiki/Schuler_tuning

6. TIA/EIA STANDARD, Electrical Characteristics of Balanced Voltage Digital Interface Circuits, TIA/EIA-422-B, May 1994

KEYWORDS: NMT; GPNTS; NoGAPSS; SCAPP; PNT; GPS; SATCOM; MILSATCOM; NAVSSI; Satellite Communications Pointing Vector

Questions may also be submitted through DOD SBIR/STTR SITIS website.