AIR FORCE
SBIR 06.3 Proposal Submission Instructions

The Air Force Research Laboratory, Wright-Patterson Air Force Base, Ohio, is responsible for the implementation and management of the Air Force SBIR Program.

The Air Force Program Manager is Mr. Steve Guilfoos, 1-800-222-0336. For general inquires or problems with the electronic submission, contact the DoD Help Desk at 1-866-724-7457 (1-866-SBIRHLP) (8am to 5pm EST). For technical questions about the topic during the pre-solicitation period (1 Aug 06 through 12 Sep 06), contact the Topic Authors listed for each topic on the website. For information on obtaining answers to your technical questions during the formal solicitation period (13 Sep 06 through 13 Oct 06), go to **http://www.dodsbir.net/sitis/.**

The Air Force SBIR Program is a mission-oriented program that integrates the needs and requirements of the Air Force through R&D topics that have military and commercial potential. Information can be found at the following website: **http://www.afrl.af.mil/sbir/index.htm.**

PHASE I PROPOSAL SUBMISSION
Please see last page of these Air Force instructions for additional special instructions for topic AF063C-011.

Read the DoD program solicitation at www.dodsbir.net/solicitation **for detailed instructions on proposal format and program requirements.** When you prepare your proposal, keep in mind that Phase I should address the feasibility of a solution to the topic. For the Air Force, the contract period of performance for Phase I shall be nine (9) months, and the award shall not exceed $100,000. We will accept only one cost proposal per topic proposal and it must address the entire nine-month contract period of performance.

The Phase I award winners must accomplish the majority of their primary research during the first six months of the contract. Each Air Force organization may request Phase II proposals prior to the completion of the first six months of the contract based upon an evaluation of the contractor's technical progress and review by the Air Force Technical point of contact utilizing the criteria in section 4.3 of the DoD solicitation The last three months of the nine-month Phase I contract will provide project continuity for all Phase II award winners so no modification to the Phase I contract should be necessary. Phase I proposals have a 20 page-limit (excluding Company Commercialization Report). The Air Force will evaluate and select Phase I proposals using review criteria based upon technical merit, principal investigator qualifications, and commercialization potential as discussed in this solicitation document.

ALL PROPOSAL SUBMISSIONS TO THE AIR FORCE PROGRAM MUST BE SUBMITTED ELECTRONICALLY.

It is mandatory that the complete proposal submission -- DoD Proposal Cover Sheet, **ENTIRE** Technical Proposal with any appendices, Cost Proposal, and the Company Commercialization Report -- be submitted electronically through the DoD SBIR website at http://www.dodsbir.net/submission. Each of these documents is to be submitted separately through the website. Your complete proposal **must** be submitted via the submissions site on or before the **6:00am EST, 13 October 2006 deadline.** A hardcopy **will not** be accepted. Signatures are not required at proposal submission when submitting electronically. If you have any questions or problems with electronic submission, contact the DoD SBIR Help Desk at 1-866-724-7457 (8am to 5pm EST).

Acceptable Format for On-Line Submission: All technical proposal files must be in Portable Document Format (PDF) for evaluation purposes. The Technical Proposal should include all graphics and attachments but should not include the Cover Sheet or Company Commercialization Report (as these items are completed separately). Cost Proposal information should be provided by completing the on-line Cost Proposal form and including the itemized listing (a-h) specified in the Cost Proposal section later in these instructions. This itemized listing should be placed as the last page(s) of the Technical Proposal Upload. (Note: Only one file can be uploaded to the DoD Submission

Site. Ensure that this single file includes your complete Technical Proposal and the additional cost proposal information.)

Technical Proposals should conform to the limitations on margins and number of pages specified in the front section of this DoD solicitation. However, your cost proposal will only count as one page and your Cover Sheet will only count as two, no matter how they print out after being converted. Most proposals will be printed out on black and white printers so make sure all graphics are distinguishable in black and white. It is strongly encouraged that you perform a virus check on each submission to avoid complications or delays in submitting your Technical Proposal. To verify that your proposal has been received, click on the "Check Upload" icon to view your proposal. Typically, your uploaded file will be virus checked and converted to PDF within the hour. However, if your proposal does not appear after an hour, please contact the DoD Help Desk.

The Air Force recommends that you complete your submission early, as computer traffic gets heavy near the solicitation closing and could slow down the system. **Do not wait until the last minute.** The Air Force will not be responsible for proposals being denied due to servers being "down" or inaccessible. Please assure that your e-mail address listed in your proposal is current and accurate. By the end of October, you will receive an e-mail serving as our acknowledgement that we have received your proposal. The Air Force is not responsible for notifying companies that change their mailing address, their e-mail address, or company official after proposal submission.

AIR FORCE SBIR/STTR VIRTUAL SHOPPING MALL

As a means of drawing greater attention to SBIR accomplishments, the Air Force has developed a Virtual Shopping Mall at http://www.sbirsttrmall.com. Along with being an information resource concerning SBIR policies and procedures, the Shopping Mall is designed to help facilitate the Phase III transition process. In this regard, the Shopping Mall features: (a) SBIR Impact / Success Stories written by the Air Force; and (b) Phase I and Phase II summary reports that are written and submitted by SBIR companies. Since summary reports are intended for public viewing via the Internet, they should not contain classified, sensitive, or proprietary information. Submission of a Phase I Final Summary Report is a mandatory requirement for any company awarded a Phase I contract in response to this solicitation.

PHASE I PROPOSAL SUBMISSION CHECKLIST

Failure to meet any of the criteria will result in your proposal being **REJECTED** and the Air Force will not evaluate your proposal.

1) The Air Force Phase I proposal shall be a nine month effort and the cost shall not exceed $100,000.

2) The Air Force will accept only those proposals submitted electronically via the DoD SBIR website (www.dodsbir.net/submission).

3) You must submit your Company Commercialization Report electronically via the DoD SBIR website (www.dodsbir.net/submission).

NOTE: Even if your company has had no previous Phase I or II awards, you must submit a Company Commercialization Report. Your proposal will not be penalized in the evaluation process if your company has never had any SBIR Phase Is or IIs in the past.

Key Personnel

Identify in the technical proposal key personnel who will be involved in this project, including information on directly related education and experience. A resume of the principle investigator, including a list of publications, if any, must be included. Resumes of proposed consultants, if any, are also useful. Consultant resumes may be abbreviated. **Please identify any foreign nationals you expect to be involved in this project, as a direct employee, subcontractor, or consultant. Please provide resumes, country of origin and an explanation of the individual's involvement.**

Phase I Work Plan Outline

NOTE: PROPRIETARY INFORMATION SHALL NOT BE INCLUDED IN THE WORK PLAN OUTLINE

At the beginning of your proposal work plan section, include an outline of the work plan in the following format:

1) Scope
   List the major requirements and specifications of the effort.
2) Task Outline
   Provide a brief outline of the work to be accomplished over the span of the Phase I effort.
3) Milestone Schedule
4) Deliverables
   a. Kickoff meeting within 30 days of contract start
   b. Progress reports
   c. Technical review within 6 months
   d. Final report with SF 298

Cost Proposal

The on-line cost proposal is part of your proposal's 20 page limit and must be at a level of detail that would enable Air Force personnel to determine the purpose, necessity and reasonability of each cost element. Provide sufficient information (a through h) on how funds will be used if the contract is awarded. Include any additional cost proposal information as an appendix in your technical proposal. The additional cost proposal information will not count against the 20 page limit.

a. Special Tooling and Test Equipment and Material: The inclusion of equipment and materials will be carefully reviewed relative to need and appropriateness of the work proposed. The purchase of special tooling and test equipment must, in the opinion of the Contracting Officer, be advantageous to the government and relate directly to the specific effort. They may include such items as innovative instrumentation and / or automatic test equipment.

b. Direct Cost Materials: Justify costs for materials, parts, and supplies with an itemized list containing types, quantities, and price and where appropriate, purposes.

c. Other Direct Costs: This category of costs includes specialized services such as machining or milling, special testing or analysis, costs incurred in obtaining temporary use of specialized equipment. Proposals, which include leased hardware, must provide an adequate lease vs. purchase justification or rational.

d. Direct Labor: Identify key personnel by name if possible or by labor category if specific names are not available. The number of hours, labor overhead and / or fringe benefits and actual hourly rates for each individual are also necessary.

e. Travel: Travel costs must relate to the needs of the project. Break out travel cost by trip, with the number of travelers, airfare, per diem, lodging, etc. The number of trips required, as well as the destination and purpose of each trip. Recommend budgeting at least one (1) trip to the Air Force location managing the contract.

f. Cost Sharing: Cost sharing is permitted. However, cost sharing is not required, nor will it be an evaluation factor in the consideration of a proposal. Please note that cost share contracts do not allow fees.

g. Subcontracts: Involvement of university or other consultants in the planning and / or research stages of the project may be appropriate. If the offeror intends such involvement, described in detail and include information in the cost proposal. The proposed total of all consultant fees, facility leases or usage fees and other subcontract or purchase agreements may not exceed one-third of the total contract price or cost, unless otherwise approved in writing by the contracting officer.

(NOTE): The Small Business Administration has issued the following guidance:

" Agencies participating in the SBIR Program will not issue SBIR contracts to small business firms that include provisions for subcontracting any portion of that contract award back to the originating agency or any other Federal Government agency." See Section 2.6 of the DoD program solicitation for more details.

Support subcontract costs with copies of the subcontract agreements. The supporting agreement documents must adequately describe the work to be performed (i.e. cost proposal). At the very least, a statement of work with a corresponding detailed cost proposal for each planned subcontract.

h. Consultants: Provide a separate agreement letter for each consultant. The letter should briefly state what service or assistance will be provided, the number of hours required and hourly rate.

PHASE II PROPOSAL SUBMISSIONS

Phase II is the demonstration of the technology that was found feasible in Phase I. Only those Phase I awardees that are **invited** to submit a Phase II proposal and all FAST TRACK applicants will be eligible to submit a Phase II proposal. The awarding Air Force organization will send detailed Phase II proposal instructions to the appropriate small businesses. Phase II efforts are typically two (2) years in duration and do not exceed $750,000. (NOTE) All Phase II awardees must have a Defense Contract Audit Agency (DCAA) approved accounting system**. Get your DCAA accounting system in place prior to the AF Phase II award timeframe. If you do not have a DCAA approved accounting system this will delay / prevent Phase II contract award. If you have questions regarding this matter, please discuss with your Phase I contracting officer.**

All Phase II proposals must have a complete electronic submission. **COMPLETE** electronic submission includes the submission of the Cover Sheet, Cost Proposal, Company Commercialization Report, the **ENTIRE** technical proposal with any appendices via the DoD submission site. The DoD proposal submission site at http://www.dodsbir.net/submission will lead you through the process for submitting your technical proposal and all of the sections electronically. Your proposal **must** be submitted via the submission site on or before the Air Force activity specified deadline. Phase II Technical proposal is limited to 50 pages. Phase II Cost Proposal information should be provided by completing the on-line Cost Proposal form and including the itemized listing (a-h) specified in the Cost Proposal section earlier in these instructions. The commercialization report, any advocacy letters, and the additional cost proposal itemized listing (a through h) will not count against the 50 page limitation and should be placed as the last pages of the Technical Proposal file that is uploaded. (Note: Only one file can be uploaded to the DoD Submission Site. Ensure that this single file includes your complete Technical Proposal and the additional cost proposal information.)

AIR FORCE PROPOSAL EVALUATIONS

Evaluation of the primary research effort and the proposal will be based on the scientific review criteria factors (i.e., technical merit, principal investigator (and team), and commercialization plan). Please note that where technical evaluations are essentially equal in merit, and as cost and/or price is a substantial factor, cost to the government will be considered in determining the successful offeror. The Air Force anticipates that pricing will be based on adequate price competition. The next tie-breaker on essentially equal proposals will be the inclusion of manufacturing technology considerations.

The Air Force will utilize the Phase I evaluation criteria in section 4.2 of the DoD solicitation in descending order of importance with technical merit being most important, followed by the qualifications of the principal investigator (and team), and followed by commercialization plan. The Air Force will use the phase II evaluation criteria in

section 4.3 of the DoD solicitation with technical merit being most important, followed by the commercialization plan, and then qualifications of the principal investigator (and team).

NOTICE: Only government personnel and technical personnel from Federally Funded Research and Development Center (FFRDC), Mitre Corporation and Aerospace Corporation, working under contract to provide technical support to Air Force product centers (Electronic Systems Center and Space and Missiles Center respectively), may evaluate proposals. All FFRDC employees at the product centers have non-disclosure requirements as part of their contracts with the centers. In addition, Air Force support contractors may be used to administratively process or monitor contract performance and testing. Contractors receiving awards where support contractors will be utilized for performance monitoring may be required to execute separate non-disclosure agreements with the support contractors.

On-Line Proposal Status and Debriefings

The Air Force has implemented on-line proposal status updates and debriefings (for proposals not selected for an Air Force award) for small businesses submitting proposals against Air Force topics. At the close of the Phase I Solicitation – and following the submission of a Phase II via the DoD SBIR / STTR Submission Site (https://www.dodsbir.net/submission) - small business can track the progress of their proposal submission by logging into the Small Business Area of the Air Force SBIR / STTR Virtual Shopping Mall (http://www.sbirsttrmall.com). The Small Business Area (http://www.sbirsttrmall.com/Firm/login.aspx) is password protected and uses the same login information as the DoD SBIR / STTR Submission Site. Small Businesses can view information for their company only.

To receive a status update of a proposal submission, click the "Proposal Status / Debriefings" link at the top of the page in the Small Business Area (after logging in). A listing of proposal submissions to the Air Force within the last 12 months is displayed. Status update intervals are: Proposal Received, Evaluation Started, Evaluation Completed, Selection Started, and Selection Completed. A date will be displayed in the appropriate column indicating when this stage has been completed. If no date is present, the proposal submission has not completed this stage. Small businesses are encouraged to check this site often as it is updated in real - time and provide the most up - to- date information available for all proposal submissions**. Once the "Selection Completed" date is visible, it could still be a few weeks (or more) before you are contacted by the Air Force with a notification of selection or non – selection.** The Air Force receives thousands of proposals during each solicitation and the notification process requires specific steps to be completed prior to a Contracting Officer distributing this information to small business.

The Principal Investigator (PI) and Corporate Official (CO) indicated on the Proposal Coversheet will be notified by Email regarding proposal selection or non - selection. The Email will include a link to a secure Internet page to be accessed which contains the appropriate information. If your proposal is tentatively selected to receive an Air Force award, the PI and CO will receive a single notification. If your proposal is not selected for an Air Force award, the PI and CO may receive up to two messages. The first message will notify the small business that the proposal has not been selected for an Air Force award and provide information regarding the availability of a proposal debriefing. The notification will either indicate that the debriefing is ready for review and include instructions to proceed to the " Proposal Status / Debriefings " area of the Air Force SBIR / STTR Virtual Shopping Mall or it may state that the debriefing is not currently available but will be within 90 days. If the initial notification indicates the debriefing will be available within 90 days, the PI and CO will receive a follow – up notification once the debriefing is available on - line. All proposals not selected for an Air Force award will have an on – line debriefing available for review. Available debriefings can be viewed by clicking on the " Debriefing " link, located on the right of the Proposal Title, in the " Proposal Status / Debriefings " section of the Small Business Area of the Air Force SBIR / STTR Virtual Shopping Mall**. Small Businesses will receive a notification for each proposal submitted. Please read each notification carefully and note the proposal number and topic number referenced. Also observe the status of the debriefing as availability may differ between submissions (e.g., one may state the debriefing is currently available while another may indicate the debriefing will be available within 90 days).**

IMPORTANT: Proposals submitted to the Air Force are received and evaluated by different offices within the Air Force and handled on a topic - by- topic basis. Each office operates within their own schedule for proposal evaluation and selection**. Updates and notification timeframes will vary by office and topic. If your company is contacted regarding a proposal submission, it is not necessary to contact the Air Force to inquire about additional submissions.** Check the Small Business Area of the Air Force SBIR / STTR Virtual Shopping Mall for a current update. Additional notifications regarding your other submissions will be forthcoming

We anticipate having all the proposals evaluated and our Phase I contract decisions by mid-February. All questions concerning the evaluation and selection process should be directed to the local awarding organization SBIR Program Manager. Organizations and their Topic numbers are listed later in this section (before the Air Force Topic descriptions).

FAST TRACK

Detailed instructions on the Air Force Phase II program and notification of the opportunity to submit a FAST TRACK application will be forwarded with all AF Phase I selection E-Mail notifications. The Air Force encourages businesses to consider a FAST TRACK application when they can attract outside funding and the technology is mature enough to be ready for application following successful completion of the Phase II contract.

NOTE:

1) Fast Track applications must be submitted not later than 150 days after the start of the Phase I contract.
2) Fast Track phase II proposals must be submitted not later than 180 days after the start of the Phase I contract.
3) The Air Force does not provide interim funding for Fast Track applications. If selected for a phase II award, we will match only the outside funding for Phase II.

For FAST TRACK applicants, should the outside funding not become available by the time designated by the awarding Air Force activity, the offeror will not be considered for any Phase II award. FAST TRACK applicants may submit a Phase II proposal prior to receiving a formal invitation letter. The Air Force will select Phase II winners based solely upon the merits of the proposal submitted, including FAST TRACK applicants.

AIR FORCE PHASE II ENHANCEMENT PROGRAM

On active Phase II awards, the Air Force will select a limited number of Phase II awardees for the Enhancement Program to address new unforeseen technology barriers that were discovered during the Phase II work. The selected enhancements will extend the existing Phase II contract award for up to one year and the Air Force will match dollar-for-dollar up to $500,000 of non-SBIR government matching funds. Contact the local awarding organization SBIR Manager for more information. (See Air Force SBIR Organization Listing)

AIR FORCE SBIR PROGRAM MANAGEMENT IMPROVEMENTS

The Air Force reserves the right to modify the Phase II submission requirements. Should the requirements change, all Phase I awardees that are invited to submit Phase II proposals will be notified. The Air Force also reserves the right to change any administrative procedures at any time that will improve management of the Air Force SBIR Program.

PHASE I SUMMARY REPORTS

All Phase I award winners must submit a Phase I Final Summary Report at the end of their Phase I project. The Phase I summary report is an unclassified, non-sensitive, and non-proprietary summation of Phase I results that is intended for public viewing on the Air Force SBIR / STTR Virtual Shopping Mall. A summary report should not exceed 700 words, and should include the technology description and anticipated applications / benefits for

government and / or private sector use. It should require minimal work from the contractor because most of this information is required in the final technical report. The Phase I summary report shall be submitted in accordance with the format and instructions posted on the Virtual Shopping Mall website at http://www.sbirsttrmall.com.

AIR FORCE SUBMISSION OF FINAL REPORTS

All final reports will be submitted to the awarding Air Force organization in accordance with the Contract. Companies **will not** submit final reports directly to the Defense Technical Information Center (DTIC).

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SPECIAL INSTRUCTIONS
For Topic AF063C-011 ONLY

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These instructions apply only to topic AF063C-011.

The Air Force plans on awarding separate Phase I awards for each of the five major technology aspects described in the topic. Each technology aspect must have its own separate proposal. Offerors may propose against one or more (including all five) of the technical aspects. Each Phase I contract will be limited to approximately $100K. We anticipate that these phase Is will be accelerated efforts to be completed in less than our traditional nine months with three months planned for the technical effort and an additional two months allowed for reporting.

The Air Force plans on awarding one (or more than one) Phase II contract worth up to $3+M. Phase II proposals will be by invitation only. At that time, special instruction will be provided for the Phase II proposals. We anticipate that the Phase II contract will develop and integrate all five technical aspects into a single capability. We also anticipate the Phase II contract will be funded as a baseline effort with at least two “gates” or decision points for continued funding. To continue, the awardee must meet all the requirements of each gate (provided in the phase II proposal invitation package). We anticipate that the phase II will be an accelerated effort to be completed in less than our traditional two years with 12 months planned for the technical effort and an additional three months allowed for reporting.

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Topic Number	Activity	Program Manager	Contracting Authority (for contract question only)
AF063-001 AF063-003 AF063-010	Sensors Directorate AFRL / SN 2241 Avionics Circle, Rm. N2S24 Building 620 Wright-Patterson AFB OH 45433-7320	B. Marleen Fannin (937) 904-9328	Kim Atkinson (937) 255-3585
AF063-002 AF063-004 thru AF063-007 AF063-009	Space Vehicles AFRL / VS 3600 Hamilton Ave, SE Kirtland AFB NM 87117-5776	Danielle Lythgoe (505) 853-7947	Jean Barnes (505) 846-4695
AF063C-011	Materials & Manufacturing Directorate AFRL / ML 2977 Hobson Way, Rm. 406 Wright-Patterson AFB OH 45433-7746	Marvin Gale (937) 255-4839	Terry Rogers (937) 656-9001

AirForce SBIR 06.3 Topic Index

AF063-001 TITLE: W-band Microwave Amplifier Power Module

TECHNOLOGY AREAS: Sensors, Electronics, Space Platforms

The technology within this topic is restricted under the International Traffic in Arms Regulation (ITAR), which controls the export and import of defense-related material and services. Offerors must disclose any proposed use of foreign nationals, their country of origin, and what tasks each would accomplish in the statement of work in accordance with section 3.5.b.(7) of the solicitation.

STATEMENT OF INTENT: Develop High Efficiency, high temp Power Modules for Space is a strongly supported goal of this PEO.

OBJECTIVE: Develop an efficient, lightweight W-band Microwave Power Module (MPM) suitable for satellite communications applications.

DESCRIPTION: In support of warfighter situational awareness, military satellite communications is scheduled to provide airborne intelligence surveillance and reconnaissance (AISR) data dissemination as well as command and control to the unmanned aerial vehicle (UAV). Because satellite communication (SATCOM) must rapidly expand to support exponentially increasing amounts of AISR data, the Air Force would like to exploit the V (50 to 75 GHz) and W (75 to 110 GHz) bands, which currently receive less use than other commonly used SATCOM bands. A combination of emerging technologies such as Monolithic Microwave Integrated Circuit amplifiers and equalizers in tandem with miniature traveling wave tube (TWT) amplifiers have created a niche device known as the microwave power module (MPM), which provides high power density at low cost. An MPM consists of an equalizer, integrated power conditioner, and TWT power booster. Typically sized at .5 ft, by .5 ft by .3 ft, MPMs provide small, efficient, light power amplification. The purpose of this topic is to develop a V/W band MPM. Goals include center frequency: 82.5 GHz, bandwidth +/- 1.5 GHz, power in < 1 mW, power out > 50W, harmonics <10 dBc, amplitude ripple <.4 dB, VSWR, <1.3:1, weight < 5 lb, efficiency > 25 percent, radiation total dose tolerance > 300 Krad (Si), and reliability consistent with 15 year satellite design life.

PHASE I: Investigate design approaches leading towards high efficiency microwave power modules. Select promising alternative and demonstrate viability through modeling and simulation. Evaluate potential benefit to commercial and military SATCOM through system analysis.

PHASE II: Fabricate a minimum of 10 MPMs. Characterize for operating frequency, bandwidth, power consumption, output power, and amplitude ripple. Conduct accelerated life testing to estimate reliability.

DUAL USE COMMERCIALIZATION: Military application: Both commercial and military satellite communications data rates are expanding and could benefit form millimeter wave communications links. Commercial application: RF based commercial satellite communications programs such as Iridium™, Globalstar™ and Spaceway™.Others:Commercial SATCOM broadcast programs such as XM™ radio, Sirius™ Radio and DirectTV™.

REFERENCES:
1. Smith, Matthew, C.; Dunleavy, Lawrence P., “Comparison of Solid State, MPM, and TWT Based Transmitters for Spaceborne Applications”, IEEE, 1998.

2. Trew, R.J.; Shin, M.W.; and Gatto, V., “Wide Bandgap Semiconductor Electronic Devices for High Frequency Applications,” IEEE GaAs IC Symposium, 1996, pp 6-9.

KEYWORDS: microwave, power module, W-band, power amplifier, gain, bandwidth

AF063-002 TITLE: Radiation Hard High Precision Agile Star Tracker

TECHNOLOGY AREAS: Space Platforms

The technology within this topic is restricted under the International Traffic in Arms Regulation (ITAR), which controls the export and import of defense-related material and services. Offerors must disclose any proposed use of foreign nationals, their country of origin, and what tasks each would accomplish in the statement of work in accordance with section 3.5.b.(7) of the solicitation.

STATEMENT OF INTENT: Intent is to develop Rad hard High precision Agile Star Tracker, a very strongly supported technology of this PEO

OBJECTIVE: Investigate schemes & technologies and/or develop a concept design for a star tracker that will provide an increased level of space environment radiation resistance for SBIRs High, SBSS, and STSS.

DESCRIPTION: Current state-of-the-art Star Trackers exhibit a susceptibility to damage from space environment radiation and may be incapable of surviving the natural radiation environment for the projected design-life of Space Based Infrared (SBIRs) High, the Space Based Surveillance System (SBSS), and the Space Tracking and Surveillance System (STSS). The desire is for continued high performance following accumulation of 300kRad(Si) of dose (proton and ionizing). Additionally, they have problems maintaining high precision during a spacecraft slew.

The projected radiation environment for these devices is 300 kRad(Si) total dose (proton and ionizing radiation) over the expected mission life. The device design goal is to minimize total degradation to < 30% in star tracker performance from beginning of life values (i.e. End of Life > 0.70 * Beginning of Life performance). The end of life performance goal is to provide inertial pointing measurement error of < 1 arc-second. In addition to radiation, other space environmental effects, like extreme temperature fluctuations, must be tolerated while providing required performance.

Optical coatings can be severely degraded by both radiation and by extreme or significant temperature fluctuations. Also, optical coatings cannot be remotely repaired when damaged or delaminated, resulting in component inoperability and potential mission failure. Specifically sought are coatings and materials that have increased resistance to damaging space environmental conditions and provide longer on-orbit operation. Materials of interest include, but are not limited to, indium gallium arsenide and silicon for the visible-near IR waveband.

Detector/focal plane arrays are also subject to damage by the space environment. Significant past efforts, as well as on-going research, has accomplished much in terms of quantifying the damage extent, morphology, phenomenology and sensor lifetime associated with radiation effects to Charge-Coupled Device (CCD) arrays. CCD-based, or other sensors such as Complementary Metal Oxide Semiconductor (CMOS) active pixel sensor devices or visible band PIN hybrids, that exhibit increased resistance to space environment radiation damage effects are highly desirable.

Also sought in this solicitation is the development of an agile star tracker that can continue to operate at “track” rate slews up to 2 degrees/second while the spacecraft is tracking. This will require either a “lost in space” feature to rapidly recover from higher rate “acquisition slews” when the star tracker is unable to operate, or the star tracker should be able to acquire data from onboard gyros to provide an initial estimate of position upon completion of the acquisition slew and system transitions to track rate slews for use when the star tracker will have to operate again.

This solicitation is broad based, from architecture changes to components to full systems. Specifically sought are new and innovative schemes and technologies that involve modified production processes, improved or new materials, altered chip packaging, unique sensor types or designs or other innovative options that will increase the intrinsic resistance of star tracker sensors to ionizing radiation damage. Increased performance during spacecraft slew is highly desirable.

Any proposal submitted must focus on one specific area: the detector/focal plane/sensor, coatings, OR an integrated unit. An offeror may submit multiple proposals, in one area, or in multiple areas.

Significant improvements to radiation and thermal adherence durability of antireflective treatments over those currently used for Star Tracker optics are required. The contractor shall demonstrate these improvements over repeated thermal excursions from –65 to +65 degrees Celsius from room temperature. A sound basis must also be shown for the radiation hardness capability of the treatment. Contractors are strongly encouraged to work with system and payload contractors to help ensure applicability of their efforts and thereby initiate the effort to transition the technology.

PHASE I: Identify and investigate materials, unique device designs, novel sensor architectures, and/or production processes suitable for star tracker component fabrication for better intrinsic radiation resistance. A proof of concept demonstration is strongly encouraged.

PHASE II: Develop and demonstrate an engineering design unit or full scale prototype that demonstrates the feasibility and efficacy of intrinsic radiation hardening of Star Trackers. In Phase II, the contractor is required to have radiation testing performed to verify that hardening to protons and total dose of 300 kRads(Si) is established and damage is minimized.

DUAL USE COMMERCIALIZATION: Military application: Radiation hardened star trackers for surveillance satellites. Commercial application: Radiation resistance star trackers enable commercial satellites to stay operational longer and therefore provide a substantial cost savings to the space industrial sector.

REFERENCES:
1. Bezooijen, R.W., “SIRTF autonomous star tracker,” Proc. SPIE Vol. 4850, p. 108-121, Mar 2003.

2. Mainzer, A.K. and E.T. Young, “On-orbit performance testing of the pointing calibration and reference sensor for the Spitzer Space Telescope”, Proc. SPIE Vol. 5487, p. 93-100, October 2004.

3. J.P. Spratt, R.E. Leadon, J.Henley, W. Byers, R. Bredthauer and R. Groulx, “P-Channel CCDs for Radiation Hardened Star Trackers”, Presented at the Heart Conference, San Antonio TX, March 2001.

4. Spratt, J.P., B.C. Passenheim, R.E. Leadon, S. Clark, and D.J. Strobel. "Effectiveness of IC Shielded Packages Against Space Radiation", T-NS, pp. 2018-2025, December 1997.

5. Janesick, J., G. Soli, T. Elliott, and S. Collins, "The Effects of Proton Damage on Charge-Coupled Devices," Proc. SPIE, Vol. 1447, pp. 87-108, 1991.

KEYWORDS: Satellite, Star Tracker, Radiation Hardening, Antireflection, Visible sensor, Agile Star Tracker

AF063-003 TITLE: Pump Laser Diode Module

TECHNOLOGY AREAS: Sensors, Electronics, Space Platforms

The technology within this topic is restricted under the International Traffic in Arms Regulation (ITAR), which controls the export and import of defense-related material and services. Offerors must disclose any proposed use of foreign nationals, their country of origin, and what tasks each would accomplish in the statement of work in accordance with section 3.5.b.(7) of the solicitation.

STATEMENT OF INTENT: Develop high power solid state lasers, a very strongly supported technology for this PEO.

OBJECTIVE: Develop reliable pump laser diode module for use in space.

DESCRIPTION: With satellite communications data rates anticipated to grow exponentially for the foreseeable future, the Air Force is interested in developing the capability for satellite based laser communications. Due to their lightweight and small size, diode pumped fiber amplifiers are highly suited for use in SATCOM laser communications applications. High power fiber amplifiers pumped by high-power single emitters have

demonstrated their advantages in terms of reliability as an optical source for laser communications. However, butterfly type cooled or uncooled pump laser diode modules in fiber amplifiers are more vulnerable to failure than some other components having longer legacy of space use. The purpose of this topic is to develop designs, materials, and methods that lead to an enhanced pump laser module reliability. The pump laser diode in the module is a single emitter, not a laser array and can be either a broad area laser or tapered laser. Goals for the module include 920-980nm wavelength, >5W CW optical output power from a fiber pigtail, >80% fiber coupling efficiency, –40 to +85ºC operating temperature range, >40% power conversion efficiency (fiber coupled optical power-to-electrical power), and >500Krads (Si) total dose.

PHASE I: Phase I will result in a proof-of-concept consisting of a comprehensive performance evaluation of candidate designs and manufacturing approaches for space qualifiable high-power pump laser modules. Emphasis will be on the potential for improved reliability and manufacturability with a complete task analysis that will include requirements and constraints with identification of reliability enhancement processes.

PHASE II: Fabricate a minimum of five prototypes. Completely characterize prototype performance including operating wavelength, output power, reliability, and radiation-tolerance.

DUAL USE COMMERCIALIZATION: Commercial applications of pump laser diode module include terrestrial fiber telecommunications and airborne laser communications. Military applications include airborne laser communications and satellite laser cross-links.

REFERENCES:
1. Albrecht, G., Peach, R.J, and Comansky, B., “High-Repetition-Rate, Diode-Pumped, Solid-State Slab Lasers,” Energy and Technology Review, University of California, June 2002.

2. Jeong, Y., Sahu, J. K.,; Payne, D. N., and Nilsson, J., “Ytterbium-doped large-core fiber laser with 1kW continuous-wave output power,” Electron. Lett. 40, 470-471, 2004.

KEYWORDS: High-power pump laser diode, butterfly package, power conversion efficiency, fiber coupling, high brightness, fiber laser/amplifier

AF063-004 TITLE: High Data Rate, Low Power Analog to Digital Converter

TECHNOLOGY AREAS: Space Platforms

The technology within this topic is restricted under the International Traffic in Arms Regulation (ITAR), which controls the export and import of defense-related material and services. Offerors must disclose any proposed use of foreign nationals, their country of origin, and what tasks each would accomplish in the statement of work in accordance with section 3.5.b.(7) of the solicitation.

STATEMENT OF INTENT: Intent is to develop low power, high conversion rate ADCs, a very strongly supported technology for this PEO.

OBJECTIVE: Develop a low power,high conversion rate analog to digital converter.

DESCRIPTION: To support of ever-increasing user demands for communications bandwidth, future generations of military communications satellites such as TSAT (Transformational Satellite) will require more capable payloads. Because the analog-to-digital converter (ADC) plays a critical role in waveform processing, the Air Force seeks the development of an ADC that enables higher order modulation waveforms for efficient use of spectrum while maintaining payload size, weight and power (SWAP) consumption within the capability of a medium launch vehicle. In order to minimize RF processing, high conversion rates allowing direct down conversion are desirable. In addition, the ADC fidelity must support RF processing of modulation modes such as 16-QAM (Quadrature Amplitude Modulation) while minimizing of errors and spurious signals. Resolution must support the depth of nulling required to counter RF (Radio Frequency) signal jamming from adversaries. The ADC must reliably operate over a mission duration that can reach 15 years in an environment that includes temperature extremes and high

radiation exposure associated with geosynchronous space operation. The objective of this topic is to develop a high conversion rate, low power, analog to digital converter capable of an effective resolution bandwidth (ERBW) > 1 GHz (sample rate >2 GSPS) and Effective Number of Bits (ENOB) >10 bits, This implies a state-of-the-art aperture uncertainty of < 100 fs. Additional goals include linearity (.5 LSB) [TBR], gain flatness <.1 dB [TBR], channel-to-channel isolation >80 dB [TBR], operating temperature range –40 to +80 deg C., power consumption <3 W [TBR] and radiation total dose tolerance > 1 Mrad (Si).

PHASE I: Evaluate satellite communications based applications & develop promising design objectives consistent with goals identified above. Conduct simulations of key subcomponents to demonstrate feasibility of meeting specifications. Assess/identify necessary considerations to ensure high reliability goals.

PHASE II: Leverage phase I results, data and information to develop and fabricate a high data rate, low power, high conversion Analog to Digital Converter (ADC) device prototype. Character the ADC part and evaluate functional and reliability test data to project specifications.

DUAL USE COMMERCIALIZATION: Military application: High data rate analog to digital converters could find use in high speed data processing for military communications applications or for space surveillance. Commercial application: HDR ADCs have a myriad of truly scalable and high fidelity transfer opportunities to the commercial world and in wide-ranging electronics applications.

REFERENCES:
1. Walden, Robert, “Analog-to-Digital Conversion Technology Comparison", IEEE GaAs IC Symposium, Technical Digest, p. 217-219.

2. Walden, Robert, “Analog-to-Digital Survey and Analysis”, IEEE Journal of Selected Areas of Communications”, 17(4):539-550, 1999.

KEYWORDS: Analog to Digital Converter, effective number of bits, sample and hold, conversion rate, flash converter, resolution

AF063-005 TITLE: Satellite Optical Communications Module

TECHNOLOGY AREAS: Space Platforms

The technology within this topic is restricted under the International Traffic in Arms Regulation (ITAR), which controls the export and import of defense-related material and services. Offerors must disclose any proposed use of foreign nationals, their country of origin, and what tasks each would accomplish in the statement of work in accordance with section 3.5.b.(7) of the solicitation.

STATEMENT OF INTENT: Developing an Optical Comm Module, a very strongly supported technology of this PEO.

OBJECTIVE: Develop and demonstrate a laser module suitable for insertion into space application.

DESCRIPTION: In order to fly optical communications systems in space, the Air Force would like to maximize the level of component integration in their optical communications systems. On board optical terminals allow fast and interference free intersatellite data transfer. Optical modules can house antennas, including the refractive telescope, liquid crystal optics for precise beam alignment and beam control for acquisition and point. In addition the optical modules can house the modulators and demodulators used for optical communications. Because space qualifiable telecom grade fiber pigtailed butterfly type cooled laser modules are hermetically sealed and reduce parts count, they are ideal candidates for use in satellite communications payloads. Components that can be integrated include DFB (distributed feedback) laser diode, modulator (either electro-absorption or Mach-Zehnder), and semiconductor optical amplifier in addition to optical isolator, collimating lens, thermoelectric cooler, thermistor, and photo diode. Wavelength tunability and wavelength locking are preferred features along with a novel fiber-coupling scheme to achieve at least 50% fiber coupling efficiency. A power reflector can be integrated with a photodiode to monitor the

laser output and control electronics to keep the optical output power constant. The purpose of this topic is to develop a space qualifiable compact cooled butterfly type laser module that is consistent with current satellite laser communications requirements, including wavelength (1550nm), data rates (at least 10Gbps), fiber coupled optical output power (at least 10dBm), and operating temperature range (-40-85 degrees C) that can be integrated into the satellite payload to provide reliable, high data rate optical communications over the typical 15 year mission life of a communications satellite.

PHASE I: Develop and analyze concepts for integrated laser modules with emphasis on development of a viable system for future satellite communications payload insertion. Address packaging issues through analysis. Demonstrate/test Phase I concepts through modeling/simulation experiments for prototype design.

PHASE II: Develop prototype of laser module meeting communication satellite payload requirements. Characterize for power consumption, output power, bandwidth, operating temperature range and radiation susceptibility from total doses and heavy ions.

DUAL USE COMMERCIALIZATION: Military application: Satellite communications systems could benefit from this technology. Commercial application: Terrestrial optical fiber telecommunications could benefit from this development.

REFERENCES:
1. Kartalopoulos, Stamatios, "Introduction to DWDM Technology," John Wiley and Sons, 2000.

2. Hainberger, R., Y. Komai, W. Klaus, K. Kodate and T. Kamiya, ¡§All-optical modules for compact free-space laser link transceivers,¡¨ Conference on Laser and Electro-optics Europe, 2000.

KEYWORDS: Bragg filter, thermoelectric cooler, photodiode, optical isolator, semiconductor optical amplifier, laser

AF063-006 TITLE: Multi-Orbit Earth Sensor for Earth Pointing and Attitude Determination

TECHNOLOGY AREAS: Space Platforms

The technology within this topic is restricted under the International Traffic in Arms Regulation (ITAR), which controls the export and import of defense-related material and services. Offerors must disclose any proposed use of foreign nationals, their country of origin, and what tasks each would accomplish in the statement of work in accordance with section 3.5.b.(7) of the solicitation.

STATEMENT OF INTENT: Develop a back-up for Earth pointing in case all primary systems for earth pointing and GPS is down, a very strongly supported technology for this PEO.

OBJECTIVE: Develop a space based Earth sensor that provides space assets with a precise reference for Earth pointing and for use in satellite attitude determination.

DESCRIPTION: The Space Based Infrared System's (SBIRS) satellite mission effectiveness is dependent upon accurate ephemerides, star sightings and continuous bore sight corrections. Past experience with DSP has been that all of these inputs are not always available. Back-up capabilities are required to control the errors and to provide redundancy for failed functions. This solicitation is pursuing a backup capability. An instrument that can be used to restore lost capabilities, dependent upon the nature of the failure or success of threat counter measures, is an Earth-image sensor/tracker that operates in the Mid-Infrared (MIR) spectrum. Earth image tracking in the visible spectrum is limited by albedo variations and/or crescent Earth images that result in large central errors. Earth images in the MIR are not subject to the crescent image and can be further protected by solar rejection filters in the Earth sensor optics. The assortment of products that can be derived from the Earth-sensor/tracker include the following (all of which can be used for the development of back-up satellite pointing and/or precise attitude determination): satellite attitude, distance to earth, IR Sensor to earth sensor bore site, MIR beacon detection/location, and signals for earth pointing.

Future survivability considerations may necessitate storing or operating satellites in an Earth pointing mode at orbit altitudes that are different from those for which they were designed. This capability may result in a graceful degradation of performance dependent upon the failure and/or countermeasures that are encountered, such as loss of GPS inputs, and the design approach of the Earth sensor itself. Scenarios may involve Earth image rotation with a fixed focal plane array or a fixed Earth image with link scanning detectors. The Earth sensor capability is desired for a variety of spacecraft configurations (i.e. 3 axis stabilized and spin stabilized) and for a range of orbit altitudes. The proposed reference should keep the satellite pointing at the Earth within 1 arc sec. accuracy regardless of design and orbit altitude.

Contractors are strongly encouraged to work with system and payload contractors to ensure a correct applicability of their efforts and thereby initiate the effort to successfully transition the technology.

PHASE I: Accumulate the data base for the Earth-sensor, select the particular band width to be used, and complete a preliminary design for the earth sensor imaging and tracker features that function over a range of orbit altitudes. Prepare a phase II development plan.

PHASE II: Build and functionally test a bread board Earth-sensor with features derived in Phase I. Define the Telemetry, Tracking, and Control (TT&C) functions and associated database to functionally interface with AIRSS or SBIRS High Block II.

DUAL USE COMMERCIALIZATION: Military application: Military communication and strategic satellites would benefit by having a back-up precision pointing and attitude control reference to utilize when primary systems fail. Commercial application: Commercial satellites can also utilize a backup pointing and attitude control reference when GPS and other systems fail.

REFERENCES:
1. Barnes, Robert B., "All Sky Scanner-Application of scanning earth sensor on spin stabilized spacecraft", Proceedings of the 15th Annual AAS Rocky Mountain Conference, Keystone, CO, Feb. 8-12, 1992 (A93-5057621-18),p.137-147, 1992.

2. NOAA Satellite and Information Service, "GOES I-M INR Compensations", http://www.oso.noaa.gov/goes/inrstat/inr_compensations.htm.

3. Suzuki, Masaharu, TOPEX/Posiedon, http://www.tsgc.utexas.edu/spacecraft/topex/index.html, 11 Feb., 1999.

4. Kallender, Paul, Solar Flare Hobbles Japanese Communications Satellite", SPACE.Com, 29 October, 2003.

5. Venkateswaran, N., et. Al., "Precision pointing of imaging spacecraft using gyro-based attitude reference with horizon sensor updates", Sadhana Vol. 29, Part 2, April 2004, pp 189-203, April 2004.

KEYWORDS: Earth-sensors, COMSATS, Earth Pointing, Earth Pointing Satellites, GPS failures, GPS, Ephemerides, Star sightings, Boresight corrections

AF063-007 TITLE: Satellite Threat and Environmental Effects Assessments for Defensive Counterspace

TECHNOLOGY AREAS: Battlespace, Space Platforms

The technology within this topic is restricted under the International Traffic in Arms Regulation (ITAR), which controls the export and import of defense-related material and services. Offerors must disclose any proposed use of foreign nationals, their country of origin, and what tasks each would accomplish in the statement of work in accordance with section 3.5.b.(7) of the solicitation.

STATEMENT OF INTENT: Intent is to have a system for Threat and Environmental effects assessments in a DCS environment, a very high priority technology for this PEO.

OBJECTIVE: Develop technologies to rapidly determine enemy ability to interfere or disable DoD, national, civilian and commercial space systems, and forecast impact of the threat and environment effects.

DESCRIPTION: A critical need exists to be able to detect and discriminate between environmental conditions, man-made threats, and internal spacecraft anomalous conditions. In addition, a need exists to determine the mission impacts of these scenarios and recommend and/or execute courses of action in order to mitigate these conditions. This capability will be needed during peacetime or periods of crisis when an adversary takes action against one or more space systems, space links, or ground systems in order to interrupt or deny the US the ability to operate in and through space and during normal or abnormal environmental events. This topic takes advantage of and builds on level 0, 1, and 2 data fusion algorithm development and data sets collected over the past several years for defensive counterspace (DCS) and space situational awareness (SSA). A sizable historical data set of Defense Satellite Program (DSP) and Defense Satellite Communications System (DSCS) surrogate threat and environment sensors, Electromagnetic Environmental Measuring System (EEMS) radio frequency downlink interference, and space environment level 0 abnormality reports, level 1 event tracks, and level 2 situation tracks exist to provide input to level 3 event and situation impact assessment data fusion. Accurate and reliable level 3 fusion in the DoD is rare, but strategically important. As a result, it is important to leverage previous work on real data to develop and extensively test level 3 data fusion capabilities for both space operations and counterspace applications.

PHASE I: The focus of Phase I is to develop and demonstrate level 3 data fusion algorithms driven by level 0, 1, and 2 fusion inputs based upon real historical satellite telemetry, EEMS, space environment, RFI, and other threat and environment effects measuring sources.

PHASE II: Build on phase I to expand evaluation with more complete historical data sets to determine if meaningful (level 3 data fusion) adversary objectives are discovered. In addition, develop a deception detected algorithm to determine the likelihood that an adversary is using a natural event to subtlely mask a hostile action.

DUAL USE COMMERCIALIZATION: Military application: Data fusion and validation tools involve underlying technology focusing on applying intelligent systems technologies to the problem of detecting anomalous situations on-board satellites. Commercial application: The underlying technology to be developed focuses on applying intelligent systems technologies to the problem of detecting anomalous situations on-board satellites.

REFERENCES:
1. Steinberg, A, Bowman, C. “Rethinking the JDL Data Fusion Levels”, NSSDF JHAPL, June, 04

2. Bowman, C. L., “The Dual Node Network (DNN) Data Fusion & Resource Management (DF&RM) Architecture” AIAA Intelligent Systems Conference, Chicago, September 20-22, 2004

KEYWORDS: Threat Assessment, Data Fusion, Space Situational Awareness, Effects Forecast, Impact, Defensive Counterspace

AF063-009 TITLE: Advanced, Lightweight Structural Materials

TECHNOLOGY AREAS: Materials/Processes, Space Platforms

The technology within this topic is restricted under the International Traffic in Arms Regulation (ITAR), which controls the export and import of defense-related material and services. Offerors must disclose any proposed use of foreign nationals, their country of origin, and what tasks each would accomplish in the statement of work in accordance with section 3.5.b.(7) of the solicitation.

STATEMENT OF INTENT: This topic has extremely high priority in meeting the technology needs of this PEO.

OBJECTIVE: Develop light weight materials, such as advanced polymer matrix composites, that lend themselves to space vehicle weight reduction.

DESCRIPTION: To support anticipated growth in battlefield communications, future generations of communications satellites will be expected to provide significantly higher levels of capacity, leading to heavier payloads. Because the structure of a space vehicle represents a significant portion of the total weight, the Air Force is seeking innovative technology developments that will lead to increased structural efficiency to allow higher payload weights. Approaches toward achieving increased structural efficiency may include the development of new materials with higher strength-to-weight or stiffness-to-weight ratios, the development of multi-function structural materials, or the development of new processes, analytical techniques, or software that enable the use of lightweight structural materials. Many material developments have occurred since the current generation of communication satellites was designed. Carbon/cyanate ester composites are replacing carbon/epoxy composites with improved outgassing, microcracking, and moisture absorption characteristics. Rigidizable/inflatable composites and shape memory composites reduce weight or packaging volume by eliminating mechanical assemblies. Carbon/aluminum and carbon/carbon composites are multi-functional, lightweight structural materials with high thermal and electrical conductance. In addition, advances in structural analysis techniques offer opportunities for markedly improving design and manufacturing processes for composite components.

Proposals should seek to address the following areas:

Suitability to the Space Environment: Demonstrate how the material and structural solution is able to meet the harsh requirements of operating in space. Include launch, storage, and integration considerations. Although not all-inclusive, the following is a list of characteristics that are pertinent for space vehicle structures: outgassing, resistance to microcracking, resistance to atomic oxygen, fracture toughness, fiber modulus translation, moisture absorption, radiation resistance, sheer strength, stiffness, process-ability, and thermal expansion.

Performance Improvement over Baseline Aluminum Structure: Provide an estimate of the mass savings possible, using the proposed solution, when compared to a traditional aluminum satellite structure.

Manufacturing Approach: Describe the manufacturing methods anticipated for the proposed solution. Do not simply include the methods anticipated in the Phase I and II, but all manufacturing methods that are amenable to the solution (i.e. filament winding, tape placement, RTM, VARTM, hot-press, hand-layup, machine-milling, ultrasonic consolidation, etc.).

PHASE I: Conduct concept design to evaluate system performance metrics for various materials/configurations. Determine suitability characteristics that require further testing. Conduct modeling & simulation, design prototype structural element(s), produce manufacturing plan. Subscale demo H/W is encouraged.

PHASE II: Conduct detailed design/fabrication of functional prototype. Interaction with DoD satellite primes is highly encouraged. Functional prototype should be to a fidelity that allows useful comparison of analytical models & test results. Demonstrate suitability to space operations. Design a conventional aluminum structure with the same performance metrics to quantify mass savings of proposed solution.

DUAL USE COMMERCIALIZATION: Military application: Both commercial and military space vehicle designs would benefit equally from advances in space materials and processes. Commercial application: Commercial space vehicle designs would benefit from advances in space materials and processes. The technology may also find wide appeal in the aeronautics, automobile and infrastructure industries.

REFERENCES:
1. Khassanchine, R. H., et. al., "Influence of UV Radiation on Outgassing of Polymeric Composites," Journal of Spacecraft and Rockets, Vol. 43, No. 2, March-April 2006.

2. Mallick, K., et. al., "Thermo-Micromechanics in a Cryogenic Pressure Vessel," AIAA-2003-1765, 44th AIAA/ASME/ASCE/AHS/ASC Structures, Structural Dynamics and Materials Conference, Norfolk, Virginia, Apr. 7-10, 2003.

3. Roy, S., et. al., "Characterization and Modeling of Strength Enhancement Mechanisms in a Polymer/clay Nanocomposite," AIAA-2005-1853, 46th AIAA/ASME/ASCE/AHS/ASC Structures, Structural Dynamics and Materials Conference, Austin, Texas, Apr. 18-21, 2005.

4. McConnell, V. P., "Tough Promises from Cyanate Esters," Advanced Composites, May/June 1992.

KEYWORDS: aluminum, polymer matrix composites, inorganic matrix composites, structural materials, materials processing, satellite

AF063-010 TITLE: Efficient Lightweight, W-band Power Combiner

TECHNOLOGY AREAS: Sensors, Electronics, Space Platforms

The technology within this topic is restricted under the International Traffic in Arms Regulation (ITAR), which controls the export and import of defense-related material and services. Offerors must disclose any proposed use of foreign nationals, their country of origin, and what tasks each would accomplish in the statement of work in accordance with section 3.5.b.(7) of the solicitation.

STATEMENT OF INTENT: This topic has extremely high priority in meeting the technonology needs for this PEO.

OBJECTIVE: Develop a satellite communication (SATCOM) W-band power combiner.

DESCRIPTION: As information technology, including the collection and mining of data, matures, effective and efficient delivery of information to the warfighter will facilitate networking of sensors, decision makers, and shooters together to translate information superiority to combat power. Bandwidth associated with, airborne intelligence, surveillance, and reconnaissance (AISR) and intelligence gathering is anticipated to increase SATCOM capacity requirements for the foreseeable future. For SATCOM to provide the additional capacity, a combination of increased spectrum efficiency, frequency reuse, and additional spectrum must be found. One source of additional spectrum lies at 71 to 76 GHz for downlink transmissions, but additional transmitter radiated power (when compared to UHF, SHF or EHF) will be required to overcome atmospheric attenuation losses as well as provide the requisite energy per bit (e.g., Eb/No) associated with higher data rates. Traveling wave tube (TWT) amplifiers have traditionally been used for high power SATCOM signal amplification. At 71-76 GHz the dimensions of the TWT elements can be expected to shrink to roughly half of an Super High Frequency or Extremely High Frequency TWT. Without power combining, the combination of smaller element dimensions, and higher output power can be expected to significantly increase operating temperatures with negative reliability consequences. The purpose of this topic is to develop a W-band TWT power combiner that would allow multiple TWTs to operate in parallel. Goals include frequency range 71 to 76 GHz, insertion loss < .3 dB[TBR], average power >300W continuous [TBR], isolation > 30 dB, phase balance +/- 1 degree, operating temperature range –40 to + 80 degrees C, and radiation total dose tolerance > 300 Krad (Si).

PHASE I: Design a power combiner meeting performance objectives identified in description. Simulate operation over full temperature range.

PHASE II: Fabricate a minimum of six prototypes and characterize for frequency range, insertion loss, output power, isolation, phase balance, and operating temperature range.

DUAL USE COMMERCIALIZATION: Military application: Military applications include satellite communications for AISR and warfighter communications. Commercial application: Commercial applications include satellite telephony, and a broad range of mobile communications made possible by access to additional spectrum at W-band.

REFERENCES:
1. Sowers, James, Pritchard, David, White, Andrew, Kong, Wendell, Tang, O.S.A., Tanner, David, and Jablinskey, Ken, .“A 36W, V-Band, Solid State Source,” IEEE MTTS-S, pp 235-238, 1999.

2. Stones, D. I. and Chow, P.D., “Q- and V-band Planar Combiners,” IEEE MTT-S Digest, pp1049-1052, 1991.

KEYWORDS: V-band, traveling wave tube, power combiner, distortion, spatial combining,

AF063C-011 TITLE: Terminally Guided Robots and Robotic Applications in Confined Spaces

TECHNOLOGY AREAS: Air Platform, Ground/Sea Vehicles, Materials/Processes

STATEMENT OF INTENT: This topic holds the greatest potential for meeting production needs of our Warfighters.

OBJECTIVE: Establish pilot manufacturing capabilities for robotic drilling in confined space aircraft inlet ducts.

DESCRIPTION: This topic describes a potential collaboration between the SBIR Program and the Defense Production Act (DPA) Title III Program. The purpose of the DPA Title III Program is to create, maintain, modernize, or expand the production capacities of domestic sources for critical components, technology items and industrial resources essential for national defense when such production capacity would otherwise be insufficient for meeting national security needs. A key objective of the Title III Program is to accelerate the transition of technologies from R&D to affordable production and insertion into defense systems. The Act authorizes a wide range of financial incentives including purchases, purchase commitments, development of substitutes, and purchase or lease of advanced manufacturing equipment for installation in Government or privately owned facilities. This pilot program will evaluate the use of SBIR to accomplish the research and development of these technologies followed by possible consideration of a follow on Title III effort. The initial focus of this partnership is for robotic drilling in confined spaces.

The Air Force is seeking to encourage the expansion of manufacturing capacity via robotic manufacturing systems for military systems and related applications. A current opportunity is for a manufacturing system capable of accurately drilling holes in confined spaces such as air inlet ducts. It is anticipated that the final system will consist of the following elements: Robot/robotic application; Drill End-Effector; Metrology System; Cutting Tools; and an Automatic Tool Changer. The application of interest requires integrating a light-weight, compact drill head that mounts to an articulating arm robot which is capable of operating inside a typical fighter jet air intake duct. The system should minimize the size and weight to permit the robot to position accurately, achieve hole size accuracies of .0015 inches and have location accuracies of .007 inches, while drilling and countersinking through various stacks of graphite epoxy composites and aluminum materials in small radii and confined spaces. Current commercial articulated arm robots, with the required payload, can not achieve required military aircraft positional accuracies. The final system may include metrology systems for hole/countersink inspection, robot positional accuracy enhancement, and actual part adjustment.

Research efforts directed toward manufacturing products will have difficulty transitioning to military or commercial usage if the research product cannot be integrated into a total higher level system. Such integration and demonstration is often critical to enable the firm to become sufficiently efficient and robust to achieve business viability and to compete against existing production companies and technologies. The Air Force seeks to create a path to larger Phase III investments by the government or private industry, and to provide a path to efficient, competitive economic viability for critical technologies integrated into a total robotic system. Although a follow-on Title III program cannot be guaranteed, a successful SBIR effort may be nominated for consideration to scale up production capacity. This determination will be made based on the following criteria: 1) The technology is essential for national defense, 2) Private industry can not or will not make the necessary investment on their own, 3) Title III assistance is the most effective way to field the technology, 4) Total demand (military & commercial) exceeds domestic capacity, and 5) A Joint or Service Program must support the effort and provide a funding offset to the Title III Program.

PHASE I: Demonstrate the feasibility of one or more of the robotic components as described above. During the Phase I effort, needed improvement for a manufacturing system will be identified. Teaming is encouraged. A complete system that will meet the production needs of future fighter aircraft is desired.

PHASE II: Fully develop the component technology to be capable of initial pilot production capability. Implement manufacturing improvements identified in the Phase I effort. Conduct a baseline capability demonstration and document initial process capability. The full system architecture should be submitted in more detail along with operator interface concepts, verification plans, and integration plans.

DUAL USE COMMERCIALIZATION: Military application: Work with a prime robotics integrator either thru the Title III program or industry to integrate a robotic arm & drilling components to include lab & full scale milestones and cell integration on the production floor. Commercial application: Accurate confined operation robotic systems for mfg have extensive use in industry. Robots are used in police, security, hazardous material handling, firefighting, military EOD, medical, etc.

REFERENCES:
1. http://www.acq.osd.mil/ott/dpatitle3/

2. http://www.jointrobotics.com/index.shtml/

3. Northrop Grumman Corporation, F-35 Inlet Duct Robotic Drilling Requirements Document (4W41-06-003), Scott Gillette, (310) 930-3969.

KEYWORDS: robot, robotics, manufacturing, drilling, inlet duct