



## **Draper Laboratory**

**DRAFT** Call for Abstracts (CFA)

University Research & Development (URAD) Program

Draper Fiscal Year 2012 (DFY12)

**CFA Issued: February 2, 2011**

**Abstracts Due: February 16, 2011**

**Period of Performance:** July 2, 2011 – June 29, 2012

### **Abstracts sought in the following areas:**

- Precision Navigation & Timing
- Strategic & Space Guidance, Navigation & Control Systems
- Tactical Guidance, Navigation & Control Systems
- Miniature, Low-Power Systems
- Autonomous Systems
- Information & Decision Systems
- Complex Reliable Systems
- Secure Networks & Communications
- Advanced / Future Technology
- Strategic Systems
- Special Operations
- Tactical Systems
- Space Systems
- Geospatial Systems and Intelligence Solutions

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## Introduction

The primary mission of the Charles Stark Draper Laboratory, Inc (Draper) is to solve our nation's hardest problems. To accomplish this mission, we maintain a strong commitment to advanced research and development, which helps us to bring new technical solutions to our customers. Another aspect of our mission is to support advanced technical education. Draper's Internal Research & Development (IRAD) program is used to develop the technologies and capabilities that best position Draper to compete for future sponsored work. Our University Research and Development (URAD) program is a specific subset of our overall IRAD program, and is designed to bring University researchers and Draper developers together to explore new areas of technology advancement. URAD funding to University teams is intended to serve a variety of possible outcomes:

- (a) Exploring the feasibility of a new technology concept for possible further development at Draper, at the University, or by some team of Draper and University;
- (b) Maturing a particular technology or concept sufficiently to enable capture of external sponsor funds for further development or implementation by the Draper-University team;
- (c) Engaging skills, capabilities, or technologies at the University which partner synergistically with Draper skills within the context of a larger program of internal and external development;
- (d) Collaborative work on a mutual topic of interest so as to build relationships that can be leveraged to develop new project, technology, and proposal ideas to capture external sponsor funds.

## New this year

Those familiar with the Draper URAD program will note several changes this year.

- 1) DRAFT call for abstracts: This year an early draft of the call for abstracts will be issued on or about December 15, 2010, and posted on our public web site and sent via email to organizations and individuals who have expressed interest in working with draper in the past. The draft call for abstracts has three primary objectives:
  - a. Provide potential university researchers and teams an additional 6 weeks of time to develop project ideas and abstracts
  - b. Provide an opportunity for feedback from the research community on the draft so as to enable clarification, refinement, and editing of the final version
  - c. To stimulate active discussion between potential researchers and Draper staff members and key points of contact, enabling researchers additional time to decide whether they want to submit an abstract at this time or to pursue other avenues of collaboration with Draper

## **Scope of URAD Program**

### **Anticipated Competition**

Abstracts that are selected for award must meet the specific needs of Draper's business, technology and R&D programs, which are in a constant state of evolution. **It is imperative that potential PIs review the attached list of project topic areas, and engage the Point of Contact for that area to discuss possible project topics.**

### **URAD Awards are Contracts, Not Grants**

Note that funded URAD projects are implemented as *contracts*, not as *grants*, and have contractual milestones, deliverables, and a statement of work. If you or your organization is not willing to work within this framework, then the Draper URAD program is not the right venue for your idea.

### **Abstract Schedule and Selection Process**

We plan the following schedule, which Draper reserves the right to change if necessary.

- Abstracts due to Draper: **February 16, 2011**
- Draper final selections & presidential approval: week of March 7, 2011
- Notifications sent to PIs: week of March 13, 2011
- Formal proposals due for projects selected for award: May 15, 2011

### **Program Implementation Schedule**

Those projects selected for funding should work with the following preliminary schedule to establish their schedules and implementation plans:

- Award notifications to proposers: week of March 13, 2011
- Request for detailed plans and final budget sent to awardees: April 4, 2011
- Detailed plans and final proposed budget due to Draper: May 15, 2011
- Contract negotiations: May 15 – June 26, 2011
- Earliest project start: July 2, 2011
- Kickoff review to be held at Draper: July or August 2011
- Mid-year review at Draper: December 2011 or January 2012
- Final review at Draper: May or June, 2012
- All work completed by June 29, 2012.

Note that the mid-year reviews are scheduled so as to allow feedback into the development of the CFA for DFY13. Delaying the mid-year review past early January can therefore reduce the possible impact of your project on the upcoming CFA.

### **Minimum Project Requirements**

All projects selected for award will include, at a minimum, a Kickoff, Mid-year, and Final review at Draper. Deliverables will include, at a minimum, the presentation material from the three reviews and a Final Report. These deliverables will be due to Draper no later than 1 week after the reviews (presentations) and three weeks after completion of the project (final report).

## **Abstract Preparation Guidelines**

All abstracts must be submitted using the Draper CFA DFY12 Form. This form will be available on our public web site ([www.draper.com](http://www.draper.com)). Expectations are that PIs have engaged the appropriate Draper Point of Contact for the relevant topic area in preliminary discussions, so that the abstract submitted should be relatively brief, providing a summary of the project concept, a description of the potential impact, an estimated budget and schedule, and a list of expected outcomes. The Draper Point of Contact will then be engaged in discussions to elaborate on the project concept during the abstract review and project selection process. Detailed guidelines for completing the abstract submission form are provided below.

### **Section A: Identification**

**Principal Investigator (PI):** Provide the full name and title of the Principal Investigator, lead researcher, or proposer for this abstract. Provide the name of the home university and department, including US Mail address, telephone number, and email address.

**Co-Investigator(s) & Affiliation(s):** Identify any major collaborations or co-investigators for this abstract. For each Co-I, provide full name and title, home university and department, US mail and email address, and telephone number. Also provide a brief (several words – up to one sentence) description of their role or contribution.

**Continuation/Evolution of prior funded Project? (Y/N):** If this abstract is a continuation or natural evolution of a currently-funded project, indicate Y (yes) and provide the title of the current project. If this is a new, stand-alone proposal, indicate N (no).

**Proposal Title:** Provide a descriptive title of your proposal; limit 256 characters.

**Topic Area(s) – indicate up to 2:** Identify the specific topic area(s) from the list that is most relevant to this abstract. Up to 2 different areas can be identified. The choices are:

- Precision Navigation and Timing;
- Tactical Systems Guidance, Navigation & Control;
- Strategic/Space Systems Guidance, Navigation, & Control;
- Miniature Low-Power Systems;
- Autonomous Systems;
- Information & Decision Systems;
- Complex Reliable Systems;
- Secure Networks & Communications;
- Strategic Systems Business Area;
- Tactical Systems Business Area;
- Space Systems Business Area;
- Special Operations Business Area;
- Geospatial Solutions Business Area;
- Advanced / Future Technology

**Person(s) at Draper with whom this abstract has been discussed:** Indicate the names of those at Draper with whom the abstract was pre-reviewed / discussed. These individuals will be asked to comment on / review your abstract.

## **Section B: Abstract Overview**

**Abstract Summary:** The abstract must contain a summary of the project not more than one page in length. It should be a self-contained description of the activity that would result if the project were funded. The summary should be written in the third person and include a statement of objectives and methods to be employed. It must clearly address in separate statements (within the one-page summary):

- the intellectual merit of the project; and
- the broader impacts<sup>1</sup> resulting from the project.

It should be informative to other persons working in the same or related fields and, insofar as possible, understandable to a scientifically or technically literate lay reader. Abstracts that do not separately address both merit review criteria within the one-page Project Summary may be considered non-compliant and rejected without further review.

**Problem being addressed:** Provide a short (up to ½ page) description of the specific problem that will be addressed.

**Competitive assessment:** Provide a short (up to ½ page) assessment of the uniqueness of the project, and identify competitive approaches or solutions, indicating relative merits of each (Why is your project “better” than the others?).

**Approach:** Provide a short (up to ½ page) description of the approach to be used to implement the project. Describe methods to be used, elements to be evaluated, figures of merit and performance / success criteria, specific tasks and activities.

**Schedule:** Provide a brief schedule that outlines the tasks, major milestones, and deliverables for the project. This can be provided as a bulleted list.

**Deliverables:** Provide a list of all deliverables to Draper (see “Minimum Requirements”, above) and provide a date when each deliverable will be provided to Draper.

**Risks:** Describe any known risks.

## **Section C: Estimated Budget /Scope**

**Personnel:** Provide an indication of the number and type of personnel that would be involved in and paid for by the project, the %level of coverage expected by the project by year, and the rough costs for each. An example is provided in the template form.

**Indirect/Non-Labor:** Provide a rough estimate for the all indirect costs associated with the project. Materials & Services should include a description of what is included (e.g. test articles; machining; consumables). Travel should include travel costs for trips to Draper for the required reviews, and for any other travel pertinent to the project. NOTE that Draper does NOT pay for conference travel. Use “Other” to capture categories unique to your project/home institution; be sure to itemize all elements. A few examples are provided in the template form.

**Contributions:** Indicate any contributions (from the home organization or other source) that will augment this research. Cost-sharing is not required. Examples can include students working for credit rather than monetary pay; use of major capital equipment without charge to the project; or inclusion of pre-existing components (or components generated in a

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<sup>1</sup> Examples of broader impacts include (among others): developing the next generation of U.S. Science, Technical, Engineering and Math (STEM) workforce; broadening participation of underrepresented groups; advancing discovery and understanding while promoting, teaching, training and learning; and benefits to society.

parallel effort) as part of the deliverables to Draper. List or describe any items included here. A few examples are provided in the template form.

## **Abstract Preparation Checklist**

Failure to meet any of the following requirements may result in the abstract being considered noncompliant and rejected without further review. If you need copies of any of the required forms, please visit the Draper public web site at [www.draper.com](http://www.draper.com).

- 1) Use the provided Abstract Submission Form and complete all sections of the form. Follow the Abstract Preparation Guidelines provided above to complete the form. This form must be submitted as a Microsoft Word document via email sent to the Draper Office of Education at [urad@draper.com](mailto:urad@draper.com).
- 2) Complete the Self-Identification form. Individuals who do not wish to provide the personal information are still required to submit a form, and should check the box indicating their desire to decline providing additional information.
- 3) Estimated cost data in the form of a not-to-exceed estimate is required. Formal cost data and proposal submission from your home institution is not required by Draper at this time; a final formal proposal will be required only for those projects selected for award.
- 4) Submit the two forms, the Abstract Submission Form and the Self-Identification form, via email to [urad@draper.com](mailto:urad@draper.com) **no later than February 16, 2011**. Hardcopy submissions will not be accepted. PDF or other formats for the electronic forms will not be accepted unless also accompanied by the Microsoft Word format forms.
- 5) Any appendices or attachments must be submitted in electronic form with the submission email and the total of all appendices or additional attachments to any one abstract cannot exceed 5MB in size.

## **Draper Fiscal Year 2012 (DFY12) URAD Project Topic Areas**

Project abstracts are sought for our Technical Capability areas, Business Area Thrusts and Advanced/Future Technology Areas. Technical Capability areas generally seek concepts for advanced technology that may be 3-10 years or more from the maturity level needed to seek customer funding for further development. Business Area Thrusts are generally seeking concepts for technologies and concepts with a shorter timeframe to maturity. Advanced/Future Technology Areas are those that we believe may be significant at Draper in the 5- to 15-year timeframe. Descriptions of the various topic areas sought are provided below. When you have identified a possible match for your concept, and **prior to abstract submittal, you must contact the individual named for that topic area** to preview your concept and determine whether further refinement or development of the concept is needed or encouraged prior to abstract submission. Discussions with the individuals named may result in decisions to pursue other avenues of collaboration and joint work rather than abstract submission to this URAD call.

### **Technical Capability Areas**

#### **Precision Navigation & Timing**

Point of Contact: Tony Radojevic, 617.258.4258, [aradojevic@draper.com](mailto:aradojevic@draper.com)

The Precision Navigation & Timing (PNT) Technical Capability addresses conceptualization of systems that provide highly precise and accurate measurements critical to determining the attitude and position of a platform, pursued through detailed system design and prototyping. These systems can include mechanical structures that house the instruments or sensors, as well as the instruments and sensors themselves, including auxiliary Guidance, Navigation, and Control (GN&C) sensors. The PNT Capability focuses on the development of a variety of enabling technologies needed for such precise sensors, instruments, and systems, including advanced imaging, MEMS/ MOEMS/ NEMS, GPS, guided optics and electro-optics, as well as atom-based technologies for quantum sensing and metrology. General applications can include attitude and position measurements on or near the Earth's surface, in the subsea environment, or in space, and can also include advanced gravimetry concepts. More specific applications of interests are outlined elsewhere in this Call for Abstracts (see, for example Strategic and Space GN&C Systems; Tactical GN&C Systems; Autonomous Systems; etc.).

Abstracts are sought in the areas of revolutionary concepts for instruments, clocks, and sensors, which enable significant improvement in performance and/or reduction in size, weight, power, and cost.

#### **Strategic & Space GN&C Systems**

Point of Contact: Tom Bucklaew, 617.258.4245, [tbucklaew@draper.com](mailto:tbucklaew@draper.com)

The Strategic and Space Guidance, Navigation and Control (GN&C) Systems Technical Capability addresses the system architecture, algorithms and software needs that relate to the GN&C of strategic, space, and missile-defense systems. The set of systems covered by this capability area is quite diverse and includes, for example: launch vehicles, strategic missiles, re-

entry bodies, interceptors, satellites, spacecraft, landers, and planetary exploration vehicles. Specific sensor technologies or mission-critical avionics required to implement algorithms of solutions will be drawn from the Precision Navigation and Timing or complex Reliable Systems capability areas, respectively, described elsewhere in this call for abstracts.

Abstracts are sought in the following areas:

- Model-based engineering techniques for strategic and space systems
- New or alternative navigation aiding techniques and/or algorithms relevant for GPS-denied or GPS-unavailable environments, including submerged vehicles and non-terrestrial landers
- Advanced “strap-down” inertial instrument calibration or navigation initialization methods that can improve navigation accuracy
- Advanced modeling, mission-planning, targeting, and flight GN&V algorithms for hypersonic glide vehicles and long-range precision strike
- Novel actuation and control methods for extremely small-scale spacecraft, i.e. “chip satellites”, as well as high altitude vehicles and formations
- Miniaturization of avionics components, specifically with respect to those that may be radiation hardened or radiation tolerant
- GN&C concepts that are enabling for spacecraft/satellite situational awareness and/or survivability
- GN&C concepts that minimize propellant and/or power usage for orbiting satellites and/or structures
- Advanced algorithm concepts for missile-defense interceptor guidance, including integrated target tracking/guidance, robustness to target maneuver, etc.

### **Tactical GN&C Systems**

**Point of contact:** Megan Mitchell, 617.258.1266, [mlmitchell@draper.com](mailto:mlmitchell@draper.com)

The Tactical GN&C capability provides innovative solutions for warfighters, weapons, sensors, and vehicles through a variety of complex, GPS-challenged environments. Relevant applications include: urban navigation, collaborative navigation, EO/IR vision-aided algorithms, UAV navigation and targeting, rapid north-finding, GN&C for guided aerial delivery, maritime vehicle GN&C, precision sensor emplacement, long-endurance/low-profile GPS-denied navigation, GPS Anti-Jam for guided munitions, and GN&C for novel projectile concepts, targeting and object geolocation. Unique approaches to algorithms, software, sensors, or systems design that advances the state of the art in these areas are of interest to this capability area.

Abstracts are sought for:

- Navigation, geo-location, and body attitude determination employing multi-sensor fusion. Component technologies of interest are vision-based and collaborative navigation with a focus on robust, low size-weight-power (SWAP) mobile processing for GPS-challenged locations
- Algorithms and sensors to provide prompt, precision, non-magnetic pointing for target geolocation
- Sensors, algorithms, and avionics systems supporting GN&C of precision guided air-drop of supplies and weapons onto fixed drop zones as well as moving platforms.
- Vision aided navigation and target tracking techniques, including feature tracking algorithms that are robust to diverse and changing environments, and landmark correlation approaches

that provide independent absolute position information

- Robust, computationally efficient guidance optimization algorithms
- Compact sensors to measure the wind profile either horizontally across terrain or vertically from an airborne platform
- New approaches to processing GNSS and modernized GPS signals for precision position, time, or attitude, or that provide a substantial improvement in solution integrity in the face of intentional or unintentional jamming or spoofing
- Systems that exploit signals of opportunity such as WiFi, radio and television transmissions, cell tower transmissions, etc., or that make novel opportunistic use of non-GNSS satellite signals

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### **Miniature Low-Power Systems**

**Point of Contact:** Elliot Ranger, 617.258.1026, [eranger@draper.com](mailto:eranger@draper.com)

The design, development, prototyping and, in some cases, low-rate production of miniature, low-power, electro-mechanical systems is an established business area for Draper. This capability includes system conceptualization and design methods for addressing demanding customer requirements, and draws upon miniature electronics packaging technology, low-power electronics design principles, and MEMS/NEMS sensor technology. Many applications also require communications (e.g., antennas, RF circuitry, analog/digital electronics) and signal processing technology.

Abstracts are sought for projects that can be implemented and demonstrated in a 3 to 5 year time horizon and that will dramatically reduce the size (thickness or volume) and power of a component and/or system; and that can provide discriminating capabilities for our customers. Currently the main drivers for overall system size are batteries (power source), antennas, and sensors. We are working to improve overall energy efficiency and algorithm efficiency to enable longer mission durations or smaller batteries (power sources). We are seeking technologies to enable the design and fabrication of complex, miniaturized electronics systems. These enabling technologies include:

- Advanced antenna technologies – including innovative approaches to packaging, materials, and form factors
- Advanced power systems– including power conversion and management, energy scavenging, tiny discrete components, power control systems, and in vitro/in vivo power sources
- Advanced communications systems – including advanced signal processing of signals such as GPS; highly power efficient receive/transmit strategies, compressive sensing and data compression.

- Advanced approaches for microsystems, possibly for biocompatibility or advanced form factors; microsystems and techniques that leverage biological systems for mutual benefit

### **Autonomous Systems**

Point of Contact: Troy Jones, 617.258.2635, [tbjones@draper.com](mailto:tbjones@draper.com)

The Autonomous Systems Technical Capability encompasses a broad set of technologies to address problems in closed-loop decision making for commanding, controlling, estimating and predicting of the state of a broad class of assets ranging from teams of heterogeneous autonomous vehicles to tasking, analysis and dissemination of information.

Abstracts are sought in the following areas:

- Autonomous Vehicle Mission Management: Novel algorithms and approaches for a variety of on-board mission management activities (which include tasking and planning, situation awareness, and situation assessment). This area also includes approaches that facilitate multi-vehicle operations and shared situational awareness; and novel approaches to facilitate operator tasking of and interaction with autonomous vehicles. Also sought are algorithms or other concepts to make autonomous vehicles more robust to unanticipated mission conditions, unstructured and highly dynamic environments, and to improve overall mission reliability.
- Assurance: techniques and approaches to assure that autonomous systems are trusted and reliable, including assurance that they have not been co-opted by hostile agents. Examples include – but are not limited to – system intrusion detection and defense and continuous self assessment of commands against a set of core values.
- Perception: Approaches and techniques that define how autonomous systems “see” or “perceive” the world to develop an understanding of their environment. Emphasis on environmental perception for underwater, ground, and air systems that utilize passive sensing is encouraged.
- Mobility & Manipulation: Approaches and techniques to advance the ability of micro (centimeter scale) and macro (meter scale) vehicles to traverse difficult terrain at speeds that are at least comparable to human ability with minimal signature (noise, heat, electromagnetic). At times during the travel, methods of interacting with the environment are desired as well. Possibilities include - but are not limited to - robust and fast legged locomotion and high strength/weight ratio dexterous manipulators. It is understood this topic may be tightly coupled to Perception and the same emphasis on passive sensing applies.

### **Complex Reliable Systems**

Point of Contact: Jeff Zinchuk, 617.258.2769, [jeff@draper.com](mailto:jeff@draper.com)

The Complex Reliable Systems capability addresses the development of system, software and hardware solutions for applications where sophisticated control and a high degree of reliability are needed, such as manned space flight systems, Unmanned Autonomous Vehicles (UAV's), and biomedical systems. This capability is also concerned with designing and building extremely complex systems of systems such as squadrons of cooperating UAV's or the control of

large electrical power grids. Capabilities that Draper brings to this field include reliable and fault tolerant system conceptualization, avionics design and analysis, and reliable computing.

Abstracts are sought in the following areas:

- Components: components that enable fault-tolerant and highly reliable system operations, such as fault-tolerant computers.
- Software Reliability: methods and approaches to modeling software complexity to enable design and development of highly reliable software and software safety.
- Subsystems: Broader than components or software, the subsystems area assesses integrated systems such as a vehicle avionics architecture and implementation.
- System of Systems: tools and methods for modeling, analyzing, and developing massive, extremely complex enterprises while enabling reliability and safety.
- Modeling and Evaluation: model-based design and analysis.
- Complex autonomous system verification and validation
- Model-Based GN&C System Design, Traceability and V&V
- Model-Based GN&C Algorithms Design
  - Model-based GN&C algorithms for high-fidelity, drift-invariant, robust, high-performance in-space operations e.g. high-precision multi-sensor pointing & tracking, rendezvous, prox-ops etc.
  - Advanced modeling, mission-planning and onboard GN&C algorithm and targeting concepts for precision re-entry vehicle and strike systems that are robust to system and environmental disturbances such as winds, thermal effects, ablation effects
  - Novel actuation and control methods for precise engagement, pointing and tracking missions with spacecraft or very high-altitude vehicle formations ; also high altitude near-space applications for single and multiple vehicles

### **Information & Decision Systems:**

Points of contact: John Irvine, 617.258.4957, [jirvine@draper.com](mailto:jirvine@draper.com)

We define Information & Decision Systems as the collection of those technologies that advance the transformation of data into information through human and/or machine systems to enable enhanced decision making; this includes aspects of human-machine collaboration, task sharing, and augmented cognition to improve human-intensive information processing in combat intelligence analysis and/or imagery analysis situations.

Abstracts are sought in the following area:

- Data-intensive discovery: Novel techniques and algorithms are sought for dramatic improvement in situational awareness and the creation of actionable knowledge given the enormous existing body of persistent data and overwhelming flood of real-time streaming data available across a variety of applications. Of particular interest are applications that develop knowledge about individuals and society. Relevant areas of research include graph analytics, game theory, human guided algorithms, semi-supervised learning, semantics, prediction, and optimization. Models of interest include physical, mathematical, and social science models, and especially their integration.

## **Secure Networks & Communications:**

Point of contact: Jim Zagami, 617.258.4883, [jzagami@draper.com](mailto:jzagami@draper.com)

The Secure Communications and Networks capability enables the reliable and efficient transport of data through and across challenging field environments. Within these environments the propagation and interference characteristics are both unknown *a priori* and rapidly varying with time. Environments of interest include the low power satellite channel, powerlines, underwater and underground, and free space optical. Networks of interest include both commercial and governmental local, metropolitan and wide-area networks.

Abstracts are sought in the following areas:

- Integrated sensing and communication architectures, achieving superior performance by means of symbiotic design. Of particular interest are communication systems associated with a guidance, navigation and control (GN&C) architecture. Communication and distributed sensor networks that depend on and/or take advantage of guidance, navigation, and control (GN&C) technologies.
- Communication methods and system architectures that achieve high overall energy efficiency. Of specific importance are systems optimized in terms of energy required to transport each data bit over a specified channel.
- Advanced communications concepts, including novel materials and approaches to enable next generation communications capabilities, and/or secure and assured communications.

## **Advanced/Future Technology Concepts**

Point of contact: Mike Matranga, [mmatranga@draper.com](mailto:mmatranga@draper.com), 617.258.2781

Draper is considering future work in a variety of technology areas that we expect will be important in the 5- to 15-year timeframe. Abstracts are sought in the following areas:

- Advanced, non-inertial sensors for navigation; including RF, acoustic, signals of opportunity, and other modalities
- Advanced cryptography
- Advanced materials; including polymer electronics, fiber electronics, and fluid electronics
- High throughput computing concepts and technologies

## **Business Area Thrusts**

### **Strategic Systems Business Area**

Point of contact: Roy Setterlund, [rsetterlund@draper.com](mailto:rsetterlund@draper.com), 617.258.4200

Strategic Systems support a variety of needs, including our current work for the Trident Life Extension project for the US Navy. We seek concepts to support future technologies to enable strapdown strategic boost guidance systems, Prompt Global Strike, re-entry guidance, g- and rad-hard components and systems; as well as novel technologies or concepts for accurate long term underwater navigation.

## **Tactical Systems Business Area**

Point of contact: Neil Adams, [nadams@draper.com](mailto:nadams@draper.com), 617.258.2411

Our Tactical Systems business area is seeking ideas to support soldier systems, munitions & precision weapons, missile defense, maritime systems (including unmanned underwater vehicles), and counter terrorism. Specifically, ideas for:

- Social network influencing and modeling of behavior, particularly as a way to automatically identify specific behaviors
- Advanced sensors and systems and/or novel approaches to enable subsurface imaging; sensors that utilize atomic physics effects to measure inertial forces
- Soldier systems, including very low cost (<\$1k) navigation and communications solutions in GPS challenged/denied environments; pedometer-based and human motion modeling techniques, velocimeters and other aiding technologies
- Missile defense: Concepts which extend enhanced ground test (EGT) methods to interceptors with closed-loop seekers
- New sensors, systems, and approaches for imaging; compressive imaging; the ability to detect features directly rather than through post-processing
- Multi-function communications enabling devices and systems, such as broadband and wide range antennas that can collect information over a broad range of frequencies
- Sensors and capabilities for maritime systems to enable autonomous operation in challenging environments

## **Special Operations Business Area**

Point of contact: Greg Cardinale, [greg@draper.com](mailto:greg@draper.com), 617.258.4614

This area focuses on technologies for ultra-miniaturized systems and novel sensor concepts. To further miniaturize and expand uses of electronic systems, we seek proposals in technology areas such as tiny, thin and flexible antennas, ultra-low power consumption architectures, micro-scale energy sources, and “smart packaging” (i.e., packaging with functionality). Sensor topics of interest include, but are not limited to, quantum sensing, non-invasive biometric sensing, and passive (near zero power) sensors. We also seek new concepts for modeling and evaluating social measures of influence; establishing attribution; large-scale graph analytics, graph sparsification, and graph databases; indirect assessments and inferences of emotional state; soft power and influence; compressive sensing for video sensors, including temporal compression; and novel audio processing.

## **Space Systems Business Area**

Point of contact: Seamus Tuohy, [stuohy@draper.com](mailto:stuohy@draper.com), 617.258.1407

Space Systems supports robotic and human space exploration as well as military space applications. We seek concepts and advanced technologies supporting human and robotic exploration; robust landing, ascent and surface operations on planets and small bodies (moons, asteroids); precision pointing both toward and away from Earth, and advanced Earth and planetary science instruments. In addition, we seek concepts and technical advancements in the development and use of small, low-power, functionally integrated systems for the mission

applications listed with particular needs for space qualified or the advancement of space qualification of said systems.

**Geospatial Systems and Intelligence Solutions Business Area**

Point of contact: Mark Chapin, [mchapin@draper.com](mailto:mchapin@draper.com), 703.403.5788

This area is primarily focused on applying novel information extraction and reporting technologies and techniques to the collection, analysis, fusion, visualization, and understanding of timely, reliable geospatial information for critical decision-making by intelligence analysts as well as warfighters. Areas of emphasis include:

- Intelligence solutions
- ISR systems and capabilities
- Precision engagement