Research Announcement
Young Faculty Award
Biological Technologies Office
DARPA-RA-16-05
February 17, 2016

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Part I: Overview Information

- **Federal Agency Name** – Defense Advanced Research Projects Agency (DARPA), Biological Technologies Office (BTO)
- **Funding Opportunity Title –** Young Faculty Award (YFA)
- **Announcement Type –** Initial Announcement
- **Funding Opportunity Number –** DARPA-RA-16-05
- **Catalog of Federal Domestic Assistance Numbers (CFDA)** – 12.910 Research and Technology Development
- **Dates**
  - Posting Date: February 17, 2016
  - Proposal Due Date: April 5, 2016, 4:00 PM ET
- **Concise description of the funding opportunity:** This Research Announcement (RA) solicits ground-breaking single-investigator proposals from junior faculty for research and development in the areas of physical sciences, engineering, materials, mathematics, biology, computing, informatics, and manufacturing of interest to DARPA's Biological Technologies Office (BTO), Defense Sciences Office (DSO) and Microsystems Technology Office (MTO).
- **Anticipated individual awards** – Multiple awards are anticipated.
- **Anticipated funding type** - 6.1
- **Types of instruments that may be awarded** – DARPA intends to award grants to eligible university faculty and nonprofit research organizations; each grant will encompass funding for a 24-month base period (a maximum of $500,000) and a 12-month option period (a maximum of $500,000).
- **Any cost sharing requirements –** None.
- **Agency contact**
  - Dr. Justin Gallivan, Program Manager
    RA Coordinator: DARPA-RA-16-05@darpa.mil
    DARPA/BTO
    ATTN: DARPA-RA-16-05
    675 North Randolph Street
    Arlington, VA 22203-2114

PROPOSERS ARE CAUTIONED THAT EVALUATION RATINGS MAY BE LOWERED AND/OR PROPOSALS REJECTED IF PROPOSAL PREPARATION (PROPOSAL FORMAT, CONTENT, ETC.) AND/OR SUBMITTAL INSTRUCTIONS ARE NOT FOLLOWED.

PROPOSERS ARE STRONGLY ENCOURAGED TO READ THE INSTRUCTIONS PROVIDED AT SECTION IV(B)(4) REGARDING THE TIME REQUIRED TO RECEIVE VALIDATION OF SUBMISSIONS MADE THROUGH GRANTS.GOV. PROPOSALS THAT ARE VALIDATED AFTER THE PROPOSAL DUE DATE/TIME WILL BE CONSIDERED LATE AND, AS SUCH, WILL NOT BE REVIEWED.

NOTE: THE TERMS "PROPOSER" AND "APPLICANT" ARE USED INTERCHANGEABLY THROUGHOUT AND REFER TO THE SINGLE INVESTIGATOR LEADING THE RESEARCH

Part II: Full Text of Announcement

Sec. I: FUNDING OPPORTUNITY DESCRIPTION

The Defense Advanced Research Projects Agency (DARPA) often selects its research efforts through the Research Announcement (RA) process. The RA is being issued, and any resultant selection will be made, using procedures under Federal Acquisition Regulation (FAR) 35.016 and Chapter 1, Subchapter C of Title 32, Code of Federal Regulations, Part 22 - Department of Defense Grant and Agreement Regulations (DoDGARs), Award and Administration. Any negotiations and/or awards will use the procedures under Part 22 of the DoDGARs and title 2 Code of Federal Regulations (CFR) Chapter 2, Part 220 – Cost Principles for Educational Institutions (OMB Circular A-21), as applicable. The RA will appear on the Grants.gov website at http://www.grants.gov/ and on the Federal Business Opportunities (FedBizOpps) website at http://www.fbo.gov/. The following information is for those wishing to respond to the RA.

The DARPA Young Faculty Award (YFA) program aims to identify and engage rising stars in junior faculty positions in academia and equivalent positions at non-profit research institutions and expose them to Department of Defense (DoD) and National Security challenges and needs. In particular, this YFA will provide high-impact funding to elite researchers early in their careers to develop innovative new research directions in the context of enabling transformative DoD capabilities. The long-term goal of the program is to develop the next generation of scientists and engineers in the research community who will focus a significant portion of their future careers on DoD and National Security issues.

DARPA is soliciting innovative research proposals in the areas of physical sciences, engineering, materials, mathematics, biology, computing, informatics, and manufacturing of interest to DARPA's Biological Technologies Office (BTO), Defense Sciences Office (DSO) and Microsystems Technology Office (MTO). Further detail regarding technical areas of interest can be found in the Technical Areas topics list. Proposals that fail to respond directly to a Technical Area will be considered nonresponsive and may not be reviewed.

Proposals responding to this RA should clearly describe the DoD problem being addressed, the current state-of-the-art technology, new insights to address the problem, a credible research plan and schedule, and critical, quantitative milestones to be pursued over the 24-month base period. Proposers should familiarize themselves with and address the Heilmeier Catechism in responding to this RA.

Proposed research should focus on innovations that will enable revolutionary advances in the selected topic area. High-risk/high-payoff ideas that could potentially transform a field or technology are strongly encouraged. Proposed research should investigate innovative approaches that enable revolutionary advances in science, devices, or systems. Specifically excluded is research that primarily results in evolutionary improvements to the existing state of practice.

Proposals that offer only incremental advances upon existing research and development (R&D) and technologies will be deemed nonresponsive to this RA and may not be reviewed.

This RA seeks proposals for a research activity consisting of a 24-month base period with a maximum funding level of $500,000. For exceptional YFA project performance over the 24-month base period, a limited number of YFA performers will be awarded a "Director's Fellowship" with a maximum of an additional $500,000 in follow-on funding for an additional estimated 12-month period.

Proposals should include a 24-month base period with the option of including a short summary of the proposed follow-on work for the estimated 12-month "Director's Fellowship" option period. The 12-month "Director's Fellowship" option period is optional and is not a requirement for proposing to this RA. During the final quarter of the YFA base period, the performers who are nominated to receive the Director's Fellowship option may be requested to submit a proposal describing efforts to be completed during the 12-month "Director's Fellowship" option.

During the 24-month base period, a number of visits/exercises at a variety of DoD sites and facilities will be scheduled. These briefings and visits will provide YFA recipients a unique, first-hand exposure to DoD personnel and technologies in the field, issues faced by the Military Services in execution of their missions, and current National Security challenges. It is expected that YFA recipients will participate in a subset of the visits/exercises made available to them. Participation in all such opportunities is not a requirement; however, lack of participation may impact the award of the Director's Fellowship. Proposers are expected to include the necessary travel funds within the total budget of their proposal.

Participation in the YFA program is limited to untenured Assistant or Associate Professors within five (5) years of appointment to a tenure-track position at a U.S. institution of higher education or equivalent at a non-profit science and technology research institution in the United States. Proposals are not being sought from foreign organizations.

Previous YFA recipients are not eligible to apply to this or any future YFA program. Applicants are limited to a maximum of three (3) applications to the DARPA YFA program during their term of eligibility. Applicants should clearly state on the cover sheet any prior YFA submissions.

Technical Topic Areas:

This RA solicits single investigator proposals for research and development in the specific technical areas of interest to DARPA's Biological Technologies Office (BTO), Defense Sciences Office (DSO) and Microsystems Technology Office (MTO) articulated below. **Proposers must specify ONE and only one of these topic areas for their proposal and identify this on the cover page.** Note: DARPA reserves the right to assign proposals to a different topic area than that which was indicated by the proposer.

Unfortunately, due to the high volume of requests for this solicitation, DARPA is unable to provide feedback on concept papers, white papers, abstracts, quad charts, proposal summaries, and curricula vitae.

Potential applicants are encouraged to carefully consider the descriptions of the topic areas before proposing. Unlike other young faculty awards, which tend to cover broad disciplinary spaces, the

DARPA YFA seeks the specific capabilities described below. Proposals that do not clearly address the specific topics may be deemed non-responsive and may not be reviewed.

Potential applicants that have questions about specific topic areas should email DARPA-RA-16-05@darpa.mil with the topic area stated in the subject line. Your question will be distributed to the appropriate contact.

Proposers are encouraged to review the DARPA mission statement and current program descriptions at the DARPA website http://www.darpa.mil/ to view examples of current DARPA investments. This is not meant as instruction to duplicate those efforts, but rather to illustrate that current programs are aimed at research that will substantially advance our capabilities in these areas. Once awards are made, each YFA performer will be assigned a DARPA Program Manager with interests closely related to their research topic. The Program Manager will act as project manager and mentor to the YFA performer.

1. Technical Area One - **Sticky Logic:** In high performance Complementary Metal-Oxide-Semiconductor (CMOS) transistor technology, a number of circuit topologies exhibited the idiosyncrasy of latching or retaining their intermediate evaluates, even after they passed operands on to subsequent stages of logic. In some cases these circuits were clocked and also acted as source/target registers; in other cases they were unclocked, behaving simply as static evaluates. A few examples of these various circuit families included Differential Cascode Voltage Switched Logic (DCVSL), Complementary Pass Gate Logic (CPL), and Swing-restored Pass Gate Logic (SRPL). As each was introduced, academia's efforts to harvest the "sticky" nature of their data retention were stymied by the higher power and device count they each incurred.

   The emergence of this sticky data behavior in a number of innovative post-CMOS devices being proposed renews the question of the potential value in retaining intermediate operands in a given cone of logic. Devices such as the Spin-torque-transfer FET (field effect transistor) and nano-magnetic logic not only perform evaluation of preceding operands, but due to their intrinsic physics, they also retain the results of the evaluation, but now within one device rather than requiring a whole circuit to do so. Currently, proposed architectures exhibiting these emerging devices are still essentially Boolean in nature, and do not exploit their machine state "stickiness". This solicitation invites the creation of alternative architectures that leverage this retention of prior machine state evaluations to reduce power, delay and layout area; or to improve transaction retirement rates and overall throughput. These architectures should complement and be compatible with a specific post-CMOS device technology. Proposers are asked to develop and model novel state machine organizations assuming a sticky post-CMOS device of their choice. Device-level models should accommodate larger scale architectural simulation while still presenting with their physical idiosyncrasies of interest. Using these models, performers must demonstrate the relative advantages of retiring workloads with these new machine organizations over existing technologies, normalizing out the individual device delay.

2. Technical Area Two - **Exploiting Nonlinearity in MEMS:** DARPA seeks innovative experimental research into the use of nonlinear dynamics in microelectromechanical systems (MEMS) to break the current paradigm that constrains device operation to the

linear regime. MEMS devices often exhibit nonlinearities due to their small size, relatively large displacements, and actuator-dependent nonlinearities. State-of-the-art MEMS sensors enhance performance by optimizing quality factor (Q) and increasing the displacements of the micro-structures but are limited by the onset of Duffing nonlinearity, which exhibits hysteresis and seemingly unpredictable behavior. The relative simplicity and ease of fabrication of MEMS devices provide a unique system for theoretical and experimental exploration into understanding and exploiting non-linear dynamics, with practical outcome for microsystems including the following applications:

- Reduced phase noise in M/NEMS oscillators
- Autoparametric excitation of linear and nonlinear devices
- Improved frequency stability via mode locking between fundamental and internal modes
- Creating nonlinear electrostatic fields in comb drives in order to tailor drive and sense nonlinearity
- Band-pass filters with large pass-band and ideal cutoff frequency rejection
- Exploiting chaotic motion for encryption
- Understanding and demonstrating mechanical nonlinearity in MEMS through the use of novel material engineering

This YFA topic will pursue theoretical, analytical, and experimental techniques to improve our fundamental understanding of nonlinearities in MEMS and develop tools, processes, and architectures for the demonstration of practical devices with enhanced performance. Applications of nonlinear dynamics to resonators, accelerometers, and gyroscopes are particularly interesting, however, other DoD interests will be considered if an application is outlined. DARPA anticipates a broad program, including all elements of innovation and invention, theoretical and numerical simulation, and experimental verification through device design, optimization, fabrication, and test.

3. Technical Area Three - **Wideband Transmitter–Antenna Interfaces:** Traditionally, antennas are designed to operate at resonance with a conjugate impedance match to the transmitter circuitry to maximize power transfer. Because the antenna geometry defines the resonant frequency, the resulting configuration is inherently narrowband as the antenna impedance changes quickly with frequency. New concepts are sought for transmitter-antenna interfaces that can overcome this bandwidth limitation. For example, the digitally-driven antenna builds on the switching power supply concept, driving the antenna with a signal encoded onto a digital pulse train and using the reactance of the antenna as a filter to convert the pulse train into a radiated analog signal. Because power transfer to the radiated signal is no longer a function of the antenna impedance in this mode, the antenna potentially can be operated with high radiation efficiency over an extremely wide signal bandwidth. Further, since the geometry of the antenna is decoupled from the operating frequency, efficient radiation may be possible from an antenna much smaller than a wavelength. Applicants to this topic should propose research on new transmitter-antenna interface concepts, using modeling and simulation for design and experimental demonstration for validation and verification. Noting that 80% of mobile tactical communications occur in the HF, VHF, and UHF bands (3 MHz - 1 GHz) where

wavelengths are large (30 cm - 100 m), this research area could have an extremely high payoff in reducing the physical size of tactical antennas for DoD communications systems.

4. Technical Area Four - **Monolithic, Integrated 3D Integrated Circuits:** DARPA seeks innovative research to develop novel 3D monolithic integrated circuit architectures that result in sharply increased computational density/performance by utilizing the out of wafer plane direction. 3D NAND and 3D X-Point technology have utilized the out of wafer plane direction to sharply increase density of memory circuits without decreasing 2D lithographic feature sizes. We seek to enable a similar increase in computational density (logic + memory + interconnect) through effective utilization of the out-of-wafer-plane direction and very high wiring interconnectivity.

   Proposed architecture approaches should be based on existing monolithic 3D fabrication processes that have been demonstrated in production or in the R&D phase. The focus of this work should be to utilize existing monolithic 3D fabrication technology to enable novel computation architectures that radically improve computational efficiency and performance without relying on decreased dimensions in the 2D plane.

   Proposed research should have the following characteristics:

   - Propose, describe, and quantitatively evaluate integrated circuit architectures that utilize monolithic 3D fabrication techniques to sharply increase computational efficiency and performance. Comparison with existing 2D computational architectures is required.
   - High bandwidth interconnect must exist within/between in-plane and out-of-plane components.
   - The work should address the full electronic system, including logic and memory.
   - Proposed architectures should be based on technology where all components are built on a single piece of silicon without the use of multichip of 3D packaging.
   - Proposed architectures should utilize existing monolithic 3D fabrication processes. The focus of this work is NOT to develop new fabrication processes. However, proposers should briefly describe the fabrication technology assumed as a foundation for the proposed architecture.
   - The architecture should depend on use of the out of wafer plane direction, not increased in-plane density to improve computational performance.

5. Technical Area Five - **Machine Learning and Many Body Physics:** DARPA seeks theoretical research into new applications of statistical and machine learning (ML) methods for physical prediction in many-body quantum systems.

   Over the last few years, there has been exciting (but limited) progress on using the tools of machine learning to make physical predictions. For example, the ground-state energy of a multi-electron atom can be regarded as a complex, non-linear function from the nuclear

number of the atom to the real line. In many cases, it may be computationally preferable to learn this function through a small number of computationally (or experimentally) expensive training examples rather than compute points using (for example) the many-body Schrodinger equation, which cannot be solved in closed form and scales extremely poorly numerically.

In particular, an application of the "ML toolbox", including kernel methods, sparse methods, (deep) neural networks, feature selection, non-linear methods, clustering, projection methods, regularization and model selection techniques has proved extremely successful in inferring physical functions from training data which comes from expensive computational solves, for example, using the Schrodinger equation or its approximants such as Density Functional Theory (DFT).

These methods are still in their infancy, however, and have only scratched the surface of new possible understanding of quantum systems. This topic seeks to develop these successes and extend their reach, in particular by exploring new algorithmic representations for physical data (that obey physical constraints, for example), learning methods that can optimally combine both computational and experimental data, and algorithms that can be applied where existing physical computational methods (such as DFT and other weekly coupled approaches) fail (for example high temperature superconductors, topological phases of matter, etc.). Particular consideration will be given to ML approaches that can be a guide to deeper fundamental physical understanding and aid in the discovery of new regions of physical parameter space.

Target applications for the DoD include possible future development in the area of new condensed matter physics such as high temperature conductivity, new materials discovery, and biological and chemical applications.

6. Technical Area Six - **System and Method to Decode Human Intent:** This YFA topic seeks novel approaches to the design of practical systems that infer human intent from observations. The goal is to facilitate the design of more effective machines that can understand humans and can seamlessly assist humans in solving real world problems at far better precision and speed than is possible today. The proposed system and approach is expected to be general and powerful in its ability to associate with a wide array of applications. Applications of interest include, but are not limited to, prosthetics, assistive devices for DoD logistic operation or manipulation tasks, autonomous vehicles, mission planning software system, interactive software, etc.

The output of the intent decoder system is expected to be a probabilistic measure of human intent, and ranked by an estimate of the confidence in the inferred value. Characterization and decoding of intent at various levels including lower level physical/motor actions, to higher level plans and goals (and sub-goals) are of interest. The input to the decoder may include any form of data acquired directly or indirectly through sensors in real-time. In this work it is expected that observation is made through multiple different modalities (at least two) such as visual or auditory signals, human physiologic signals such as EEG, brain-machine interface (BMI), and human behavior such as physical movement, posture, hand

shape, eye tracking, etc. The goal is to operate in real-time or near real-time. Proposers must clearly describe the proposed signal processing architecture, methods, algorithms, and metrics separately for learning/modeling phase, for real-time operation phase, and their interactions. Although the main objective is to address collaboration between a single human and one or more machines, methods that can be generalized to infer intents from a group of people during group interactions are welcomed.

Proposers should clearly describe justification for sensor signals and modality types used in their approach, and provide a compelling reason how each modality improves the performance of the final system. Proposers should also explicitly describe innovations in their analytical framework for multi-model signal fusion and inference, and state their metrics and methods of evaluation. Proposers should describe how their proposed approach addresses limitations of current approaches in this space and will result in transformative understanding beyond our current knowledge.

7. Technical Area Seven - **Characterizing the Performance Envelope of Emergent Behavior and Evolutionary Selection in Real-world Systems:** Naturally-occurring collective systems appear to demonstrate a wide variety of desirable characteristics, such as adaptability, robustness, and super-additive performance scaling. Similarly, evolutionary processes seem to find novel solutions over complex fitness landscapes with relative efficiency and parsimony. Artificial systems and algorithms have been developed that can replicate many of these natural dynamics, often with surprisingly simple functional forms. However, these replications have occurred mostly in simulation, using non-physical idealized agents and abstract fitness landscapes. When applied to real-world systems, many of these desirable characteristics do not reliably manifest themselves, and the hypothesized performance gains remain unproven.

This topic area seeks fundamental research in characterizing the performance of behaving collectives and/or evolving systems in real-world environments, with a focus on empirical or observation-constrained theoretical work. Focus areas include, but are not limited to:

- Genetic algorithms applied holistically in real-world environments; e.g., co-evolving controllers for constituent subsystems of a larger platform
- Quantification of robustness of emergent collective systems via perturbation
- Formal performance, resilience, and cost trade-off studies for unitary vs. collective and homogenous vs. heterogeneous systems
- Resilience against active adapting adversaries; e.g., are simple interaction rules easily uncovered, and if known, easily disrupted?
- Adaptive metaheuristics for emergence; e.g., how readily does emergent collective behavior evolve, and how does it respond to a shifting fitness landscape?

8. Technical Area Eight - **Advancing Live Cell Super-Resolution Imaging:** Super-resolution microscopy involves tools and techniques that bypass the diffraction limit, the stipulation that an optical microscope cannot yield a resolution better than approximately 200 nanometers ($\lambda/2$). Imaging the activity of individual molecules in living cells has recently been achieved using a number of super-resolution microscopy techniques such as

Stimulated Emission Depletion (STED), Structured Illumination Microscopy (SIM), Stochastic Optical Reconstruction Microscopy (STORM), or Spectral Precision Distance Microscopy (SPDM). Imaging molecular activity at these sub-wavelength resolutions, however, compromises the depth, sensitivity, and speed of image acquisition. Furthermore, live cell imaging applications are restricted to single-cell layers cultured on glass coverslips; this eliminates the influence of their native environment and adjacent tissues.

Utilization of adaptive optics can overcome scattering issues in optical microscopy. Adaptive optic technologies improve the performance of optical systems by reducing the effects of wavefront distortions through the use of deforming mirrors. Historically, adaptive optics have been applied to astrophysics applications, but in recent years biologists have adopted the same techniques to compensate for scattering by surrounding tissues in order to improve resolution. The combination of adaptive optics with super-resolution microscopy may overcome issues related to imaging at greater depths.

DARPA seeks to significantly advance super-resolution live cell imaging to ex vivo, or in vivo settings, where cellular processes are more physiologically relevant. As such, DARPA seeks innovative theoretical and experimental research to develop methods by which the following metrics may be simultaneously achieved:

- Sub-wavelength resolution
- 3-dimensional or multiplane volumetric imaging at speeds faster than a few thousand voxels per second
- Imaging through more than a few hundred micrometers of living tissue

9. Technical Area Nine - **"Smart" Fabrics for Soldier Health:** DARPA is interested in exploring technologies that can mimic the rapid color changes observed in nature by species such as the cuttlefish, octopi, and chameleons.

This topic seeks to identify specific technology solutions that could be exploited for integration into flexible fabrics. Areas of research could include, but are not limited to; synthetically developed proteins that mimic those seen in nature that allow for color switching in the visual and/or infrared regime, prediction software to rapidly detect and respond to changing environments and integration of materials into flexible fabrics.

Target applications relevant to the military include: Advanced "smart" fabrics with integrated capability to predict health of the Soldier. The final fabrics would allow for real time visual color shifts with sufficient weight and power requirements.

10. Technical Area Ten - **The Science of Individualized Gamification:** Gamification is defined as using game mechanics and dynamics to drive "game-like" engagement for a non-game context or task, thereby increasing enjoyment, learning, and performance on that task or in that context. Some research suggests that gamification can be a powerful tool for teaching new skills, encouraging citizen-science efforts, collective problem-solving, and helping people adopt new behavioral habits that can demonstrably improve their health

and performance (for example, by gamifying exercise, nutrition, stress management, or sleep hygiene).

However, not all gamified approaches are successful. One reason may be that any given gamified approach may be designed in a way that appeals to a specific kind of user - with a specific kind of motivation (where that is defined as the reason or reasons that shape the desire or willingness one has for doing a particular thing or behaving in a particular way). If the game design does not mesh with or adapt to an individual's personality or motivational state, then it may fail to engage that user. In the same way, many social and behavioral research studies assume that each study participant is equally as motivated by the experiment's premise, task, or incentive. However, this assumption is unlikely to be true given the wide variability and reasons individuals may have for agreeing to participate in a study – just as individuals may have different kinds and levels of motivation when engaging with a particular gamified task or platform. Currently, there is very little research on ways to capture individual measures that may shape motivational states or goals of participants beyond often unreliable self-report measures, and this wide motivational variability could be dramatically impacting the interpretation of research results as well as limiting the wider utility and success of different gamification approaches.

Accordingly, DARPA is interested in revolutionary approaches and tools that could help close this gap between gamification mechanics and individual characteristics and motivation in order to advance the science of individualized gamification. DARPA is particularly interested in research that could lead to new capabilities for:

- Accurately detecting and categorizing an individual's characteristics and motivational state at a given time in order to rapidly adapt gamification dynamics, mechanisms and/or incentives for that individual;
- Demonstrating this approach's ability to improve the success of gamification in accelerating learning, problem solving, and/or performance compared to one-size-fits all or adaptive training; and
- Developing and validating design principles based on this rapid detection of individual motivational states for wider application, such as with human-machine teaming.

11. Technical Area Eleven - **Accuracy and Uncertainty in Design: How Sloppy Can We Be?:** Accuracy, or lack thereof, and uncertainty are an unfortunate burden that is part of all engineering design and fabrication. The first problem is the error introduced by the limits of floating point computations, data structures, and algorithmics to represent and analyze the shapes to be produced. It affects everything from describing the desired shape accurately, computing properties, moving design specifications between systems, and predicting the physical behavior of the assembled product with some degree of certainty.

The second problem is the variations introduced by the entire manufacturing process chain. Material properties have a degree of uncertainty associated with them; each fabrication process introduces variations to the desired shape and material properties. Additive manufacturing techniques and carbon fiber production introduce additional challenges

because they enable even more complex material properties and shapes to be created. As a consequence, a designer is faced with an increasingly difficult task to distribute the allowable variations to the shapes and properties to create a functioning product that achieves or exceeds a set of performance targets.

There have been several attempts to address these individual problems. These include accuracy in shape representations; Design Under Uncertainty (DUU) and Uncertainty Quantification (UQ); and Geometric Dimensioning and Tolerances (GD&T) to describe allowable production variations. Faced with increasingly complex design challenges, can we create a unified theory of accuracy that will serve as a new mathematical and computational foundation for design and be able to tie computational accuracy to fabrication variations and product performance? In other words, how sloppy can a design be and still work?

DARPA is seeking transformative proposals that leverage and combine ideas rooted in one or more disciplines such as: mathematics; probability, statistics and uncertainty; geometry; approximation theory and response modeling; topology; optimization; computer science; mechanical design and fabrication to address the current limitations in this space.

12. Technical Area Twelve - **Gene Therapy Technology and Tools:** While genomic research has clearly identified a number of genetic therapy targets that affect disease states, there has been limited translation of gene therapies to clinical use. A key barrier hindering wider adoption of gene therapies for human patients is the lack of tools and technologies to test these therapies without risk of permanently editing a patient's germ-line DNA. As a result, current gene therapy methods have a small but not insignificant risk of off-target effects that may be difficult to reverse in the event of adverse effects. This program topic seeks new approaches that promise to substantially reduce, and perhaps even eliminate, this risk by incorporating intrinsic controls and limits to the duration and spatial extent of such therapies, and to offer mechanisms to tag, observe, and verify the limitations and extent of the gene therapy effects beyond the target tissue or experimental duration.

This YFA topic seeks to develop and demonstrate these novel techniques to limit the spatial and temporal transfection of tissue, improve cellular-level transfection and/or gene activation specificity and targeting, and to increase the efficiency of transfection. Proposed techniques and tools may include, but are not limited to: cellular-specific targeting, mRNA, highly-localized treatments, and methods with predictable degradation over time. Proposals should include detailed experimental protocols that will unambiguously demonstrate the hard limits imposed by the proposed technique. For example, an RNA-based approach must demonstrate that the RNA has not been replicated or incorporated into any nuclear or mitochondrial DNA. A time-limited approach must demonstrate that there is no measurable quantity of the therapeutic agent in any tissue after the expected limit. A spatially-limited approach must demonstrate that there are no traces of the therapeutic agent outside the targeted region. A cellular limit to transfection must demonstrate that there are no traces of the therapeutic agent in non-targeted cells. Any proposed combination of these approaches must demonstrate verification of all appropriate limits.

DARPA is not interested in proposals that may result in unintentional transfection outside a target region, permanent alteration of any genetic or epigenetic material, or any technique that may diffuse, replicate, or otherwise remain resident in an individual after the therapy has ended. Proposals should define a credible trajectory from exploration of these inherently limited mechanisms to human translation. No human research will be accepted under this topic.

13. Technical Area Thirteen - **Multi-Scale Models of Infectious Diseases Dynamics:** The ability to predict the emergence and spread of infectious diseases is a national security priority. This topic area aims to develop improved methodologies and tools for forecasting the emergence and spread of infectious diseases. Specifically, DARPA seeks the capability to model and predict disease dynamics across biological scales – from the molecular, to cellular, to individual, to population level. Models should provide an assessment on population susceptibility to the pathogen under consideration, as well as the potential impact and severity of disease. Of particular interest are nested models (or embedded models) that are capable of predicting the dynamics of disease using data from multiple scales of biology and the environment (e.g., molecular, host immunity, behavior, travel patterns, weather, etc.). The proposer should clearly state the data sources, model parameters, and anticipated outputs. Attention should be given to balancing model complexity with the potential benefits of increased accuracy from the multi-level nested models. The pathogen(s) considered within this effort should be limited to those that cause severe pathology and have the potential to cause significant health, economic, and social burden. At the end of the project, the proposer should demonstrate superior accuracy of a multi-scale model as compared to state-of-the-art approaches. Beyond accuracy, the proposer is encouraged to include additional metrics to describe the performance of the proposed model. While beyond the scope of this YFA project, proposers are encouraged to consider features (e.g., graphical front-end interfaces) that could aid stakeholders in the adoption of the proposed models for operational use (e.g., clinicians, hospital administrators, and public health officials).

14. Technical Area Fourteen - **Microbiomes for Maritime Provenance:** The microbiome of ocean-going vessels develops in both the bilge water of the ship and across ship surfaces. Understanding the microbiome of a ship may enable insights as to overall ocean health, but also could serve as a means for establishing and verifying the provenance of a vessel. Questions of interest in this YFA include: (1) Establishing the basics of microbiome development on the surfaces of ocean-going vessels and in their bilge water, including composition of communities and rate of change of microbiomes; (2) Understanding how transit may affect the microbiome of an ocean-going vessel; (3) Assessing microbial variance between geospatial locations (i.e., ports, harbors, bodies of water); and (4) Generating assays capable of associating microbial communities in the bilge water of vessels with specific geospatial locations. Proposals should outline a method for establishing the microbiome of no less than five distinct geospatial locations on three or more continents, as well as develop a model of assessment that would allow for a microbiome community to be compared to the established route of a vessel for verification and validation purposes. Proposals should describe a demonstration of technology at two

or more distinct harbors or ports located on separate bodies of water. Proposals should describe variance and variability between the microbiomes of two or more vessels that transit a similar route defined as no greater than a 50 km variation in difference and occurring no greater than seven days apart.

15. Technical Area Fifteen - **Nanofluidics for Biotic-Abiotic Interfaces:** Engineering seamless interfaces between biological systems, such as cells or organs, and conventional devices, such as electrode arrays, is becoming increasingly critical for advancing practical applications of biotechnologies important to national security. To effectively integrate these biotic and abiotic systems, interfaces must be designed to operate at each of the spatial and temporal scales of the biological system, from microscopic biomolecules to macroscopic tissues. Existing techniques are rudimentary. For example, recording brain activity currently involves the simple placement of microfabricated electrodes in physical proximity to brain tissue, with researchers relying on the brain itself for translation of the chemical signals into electrical pulses. To expand our capabilities for interfacing with arbitrary biological systems, a general technology is required to capture the full spectrum of biological signaling by conventional devices.

Nanofluidic technology represents a promising path forward in this regard for several reasons. First, the scales of nanofluidic structures match those relevant to cellular structures and processes. This opens possibilities for the use of nanofluidic interfaces intercellularly, intracellularly, or to augment part of a biological cell. Second, nanofluidic devices offer a facile means to bring the aqueous biological environment into controlled contact with conventional device components. Third, nanofluidic phenomena are dominated by surfaces, which become electrically charged in fluids, thus allowing for natural electronic transmission of information encoded in an aqueous state to and from the biological system of interest. Finally, nanofluidic fabrication methods are compatible with standard techniques used for conventional devices, so that the nanofluidic and electronic components may be integrated seamlessly. However, new nanofluidic architectures and substrates, such as polymeric or biological materials, may be required to interface with biological systems for the purposes discussed here.

DARPA seeks to achieve maximal information exchange at all scales of the biotic-abiotic interface by advancing nanofluidic technology to serve as a signal transducer between conventional electronics and biological systems. For this call, DARPA is interested specifically in scientists and engineers who are able to work collaboratively across the fields relevant to fluidic devices and biology, to demonstrate both proof of concept and practical utility for new technological capability in interfacing biological systems and conventional devices.

Sec. II. AWARD INFORMATION

Multiple awards are anticipated. The amount of resources made available under this BAA will depend on the quality of the proposals received and the availability of funds.

The Government reserves the right to select for negotiation all, some, one, or none of the proposals received in response to this solicitation, and to make awards without discussions with proposers. The Government also reserves the right to conduct discussions if it is later determined to be necessary. If warranted, portions of resulting awards may be segregated into pre-priced options. Additionally, DARPA reserves the right to accept proposals in their entirety or to select only portions of proposals for award. In the event that DARPA desires to award only portions of a proposal, negotiations may be opened with that proposer. The Government reserves the right to fund proposals in phases with options for continued work at the end of one or more of the phases.

Awards under this RA will be made to proposers on the basis of the evaluation criteria listed below (see section labeled "Application Review Information", Sec. V.), and program balance to provide overall value to the Government. The Government reserves the right to request any additional, necessary documentation once it makes the award instrument determination. Such additional information may include, but is not limited to, Representations and Certifications. The Government reserves the right to remove proposers from award consideration should the parties fail to reach agreement on award terms, conditions and cost/price within a reasonable time or the proposer fails to timely provide requested additional information.

Fundamental Research

It is DoD policy that the publication of products of fundamental research will remain unrestricted to the maximum extent possible. National Security Decision Directive (NSDD) 189 established the national policy for controlling the flow of scientific, technical, and engineering information produced in federally funded fundamental research at colleges, universities, and laboratories. The Directive defines fundamental research as follows:

> 'Fundamental research' means basic and applied research in science and engineering, the results of which ordinarily are published and shared broadly within the scientific community, as distinguished from proprietary research and from industrial development, design, production, and product utilization, the results of which ordinarily are restricted for proprietary or national security reasons.

As of the date of publication of this RA, the Government expects that program goals as described herein may be met by proposers intending to perform fundamental research. The Government does not anticipate applying publication restrictions of any kind to individual awards for fundamental research that may result from this RA. Notwithstanding this statement of expectation, the Government is not prohibited from considering and selecting research proposals that, while perhaps not qualifying as fundamental research under the foregoing definition, still meet the RA criteria for submissions. If proposals are selected for award that offer other than a fundamental research solution, the Government will either work with the proposer to modify the proposed statement of work to bring the research back into line with fundamental research or else the proposer will agree to restrictions in order to receive an award.

Proposers should indicate in their proposal whether they believe the scope of the research included in their proposal is fundamental or not. While proposers should clearly explain the intended results of their research, the Government shall have sole discretion to select award instrument type and to

negotiate all instrument terms and conditions with selectees. Appropriate clauses will be included in resultant awards for non-fundamental research to prescribe publication requirements and other restrictions, as appropriate.

When submitting material for written approval for open publication, the contractor/awardee must submit a request for public release to the DARPA/PRC and include the following information: (1) Document Information: document title, document author, short plain-language description of technology discussed in the material (approx. 30 words), number of pages (or minutes of video) and document type (e.g., briefing, report, abstract, article, or paper); (2) Event Information: event type (conference, principal investigator meeting, article or paper), event date, desired date for DARPA's approval; (3) DARPA Sponsor: DARPA Program Manager, DARPA office, and contract number; and (4) Contractor/Awardee's Information: POC name, e-mail and phone. Allow four weeks for processing; due dates under four weeks require a justification. Unusual electronic file formats may require additional processing time. Requests may be sent either via email to public_release_center@darpa.mil or by mail to 675 North Randolph Street, Arlington VA 22203-2114, telephone (571) 218-4235. Refer to the following for link for information about DARPA's public release process: http://www.darpa.mil/work-with-us/contract-management/public-release.

Sec. III: ELIGIBILITY INFORMATION

A. Eligible Applicants

This RA solicits single-investigator proposals for research and development in the specific Technical areas of interest to DARPA's Biological Technologies Office (BTO), Defense Sciences Office (DSO) and Microsystems Technology Office (MTO) as outlined in Part II, Section I. This RA does not allow subcontractor(s) or principal investigator(s).

Participation is limited to untenured Assistant or Associate Professors within five (5) years of appointment to a tenure-track position at a U.S. institution of higher education or equivalent at a non-profit science and technology research institution in the United States.

Previous YFA recipients are not eligible to apply to this or any future YFA program. Applicants are limited to a maximum of three (3) applications to the DARPA YFA program during their term of eligibility. Applicants should clearly state on the cover sheet any prior YFA submission(s).

Applicants are also limited to ONE submission to this RA. "Applicants" refers to the individual faculty member and not the institution. There is no limit to the number of applications that can be submitted by an institution, as long as each application lists a single principal investigator. Investigators may only propose to one topic area each. Submission to young investigator programs sponsored by other agencies is not restricted.

Proposers should provide in their proposal a listing of past, current, and pending support, including sponsor, funding level, performance dates, and level of all federally-funded research efforts. DARPA is particularly interested in identifying outstanding researchers who have previously not

been performers on DARPA programs, but the program is open to all qualified applicants with innovative research ideas. If you have been awarded (non-YFA) DARPA funding, you are eligible to propose to this RA. If you have been or currently are a performer on a DARPA program, please list this clearly on the cover sheet as indicated in Section IV.B.3.a.

All responsible sources capable of satisfying the Government's needs may submit a proposal that shall be considered by DARPA.

Unless otherwise stipulated herein, non-U.S. individuals may participate to the extent that such participants comply with any necessary nondisclosure agreements, security regulations, export control laws, and other governing statutes applicable under the circumstances.

B. Procurement Integrity, Standards of Conduct, Ethical Considerations, and Organizational Conflicts of Interest

Current federal employees are prohibited from participating in particular matters involving conflicting financial, employment, and representational interests (18 U.S.C. §§ 203, 205, and 208). Once the proposals have been received, and prior to the start of proposal evaluations, the Government will assess potential conflicts of interest and will promptly notify the proposer if any appear to exist. The Government assessment does NOT affect, offset, or mitigate the proposer's responsibility to give full notice and planned mitigation for all potential organizational conflicts, as discussed below.

Without prior approval or a waiver from the DARPA Director, in accordance with FAR 9.503, a contractor cannot simultaneously provide scientific, engineering, technical assistance (SETA) or similar support and also be a technical performer. As part of the proposal submission, all members of the proposed team (prime proposers, proposed subcontractors, and consultants) must affirm whether they (their organizations and individual team members) are providing SETA or similar support to any DARPA technical office(s) through an active contract or subcontract. All affirmations must state which office(s) the proposer, subcontractor, consultant, or individual supports and identify the prime contract number(s). All facts relevant to the existence or potential existence of organizational conflicts of interest (FAR 9.5) must be disclosed. The disclosure must include a description of the action the proposer has taken or proposes has taken to avoid, neutralize, or mitigate such conflict. If in the sole opinion of the Government after full consideration of the circumstances, a proposal fails to fully disclose potential conflicts of interest and/or any identified conflict situation cannot be effectively mitigated, the proposal will be rejected without technical evaluation and withdrawn from further consideration for award.

If a prospective proposer believes a conflict of interest exists or may exist (whether organizational or otherwise) or has questions on what constitutes a conflict of interest, the proposer should send his/her contact information and a summary of the potential conflict via email to DARPA-RA-16-05@darpa.mil before time and effort are expended in preparing a proposal and mitigation plan.

Sec. IV: APPLICATION AND SUBMISSION INFORMATION

A. Address to Request Application Package

This solicitation contains all information required to submit a proposal. No additional forms, kits, or other materials are needed. This notice constitutes the total RA solicitation. No additional information is available nor will a formal Request for Proposal (RFP) or additional solicitation regarding this announcement be issued. Requests for the same will be disregarded.

B. Content and Form of Application Submission

DARPA policy is to treat all submissions as source selection information (see FAR 2.101 and 3.104), and to disclose their contents only for the purpose of evaluation. Restrictive notices notwithstanding, during the evaluation process, submissions may be handled by support contractors for administrative purposes and/or to assist with technical evaluation. All DARPA support contractors performing this role are expressly prohibited from performing DARPA-sponsored technical research and are bound by appropriate nondisclosure agreements.

Submissions will not be returned. The original of each submission received will be retained at DARPA and all other non-required copies destroyed. A certification of destruction may be requested, provided the formal request is received at this office within five (5) days after unsuccessful notification.

1. Security Information

The Government anticipates proposals submitted under this RA will be UNCLASSIFIED. It is NOT a requirement of the RA that proposers be eligible to obtain a U.S. security clearance.

2. Proprietary Information

Proposers are responsible for clearly identifying proprietary information. Submissions containing proprietary information must have the cover page and each page containing such information clearly marked with a label such as "Proprietary" or "Company Proprietary." Note, "Confidential" is a classification marking used to control the dissemination of U.S. Government National Security Information as dictated in Executive Order 13526 and should not be used to identify proprietary business information.

3. Proposal Submission Information

The YFA proposal process consists of a full-proposal submission only. **There will not be a proceeding abstract phase.** Proposers are required to submit full proposals by the time and date specified in the RA. **Early submission of full proposals is strongly encouraged. Applicants are strongly encouraged to discuss their YFA submission with their Office of Sponsored Research (or equivalent) several weeks in advance of the submission deadline.** DARPA will review all full proposals submitted using the published evaluation criteria. The typical proposal

should express a consolidated effort in support of one or more related technical concepts or ideas. Disjointed efforts should not be included into a single proposal.

All administrative correspondence and questions on this solicitation, including requests for information on how to submit full proposal to this RA should be directed to DARPA-RA-16-05@darpa.mil . DARPA intends to use electronic mail for correspondence regarding DARPA-RA-16-05. DARPA encourages use of the Internet for retrieving the RA and any other related information that may subsequently be provided.

THIS RA SEEKS ONLY GRANT PROPOSALS. PROPOSALS FOR ANY OTHER INSTRUMENT TYPE WILL BE CONSIDERED NON-CONFORMING WITH THE RA AND WILL NOT BE REVIEWED.

Proposers must submit proposals through Grants.gov by electronic upload per the instructions at http://www.grants.gov/applicants/apply-for-grants.html. **Proposals may NOT be submitted through any other means.**

Grants.gov requires proposers to complete a one-time registration process before a proposal can be electronically submitted. If proposers have not previously registered, this process can take between three business days and four weeks. See the Grants.gov registration checklist at http://www.grants.gov/web/grants/register.html for registration requirements and instructions.

Once Grants.gov has received a proposal submission, Grants.gov will send two email messages to advise proposers as to whether or not their proposals have been validated or rejected by the system; IT MAY TAKE UP TO TWO DAYS TO RECEIVE THESE EMAILS. The first email will confirm receipt of the proposal by the Grants.gov system; this email only confirms receipt, not acceptance, of the proposal. The second will indicate that the application has been successfully validated by the system prior to transmission to the grantor agency or has been rejected due to errors. If the proposal is validated, then the proposer has successfully submitted their proposal. If the proposal is rejected, the proposed must be corrected and resubmitted before DARPA can retrieve it. If the solicitation is no longer open, the rejected proposal cannot be resubmitted. Once the proposal is retrieved by DARPA, the proposer will receive a third email from Grants.gov. To avoid missing deadlines, proposers should submit their proposals in advance of the final proposal due date with sufficient time to receive confirmations and correct any errors in the submission process through Grants.gov. For more information on submitting proposals to Grants.gov, visit the Grants.gov submissions page at:
http://www.grants.gov/web/grants/applicants/apply-for-grants.html.

Technical support for Grants.gov submissions may be reached at 1-800-518-4726 or support@grants.gov.

Proposals may not be submitted by fax or email. Any proposal sent via these methods will be disregarded and will not be reviewed.

4. Full Proposal Format

All full proposals must be in the format given below. Nonconforming proposals may be rejected without review. Proposals shall consist of two volumes. All pages shall be formatted for printing on 8-1/2 by 11 inch paper with type not smaller than 12 point. Smaller type sizes may be used for figures, tables and charts. As the typeface and margin sizes are not explicitly stated in the RA, DARPA advises you to use styles and margins that would otherwise be considered reasonable or standard. **The page limitation for full proposals includes all figures, tables, and charts.** Volume I, Technical and Management Proposal, may include an attached bibliography of relevant technical papers or research notes (published and unpublished) that document the technical ideas and approach upon which the proposal is based. Copies of not more than three (3) relevant papers may be included with the submission. **The bibliography and attached papers are not included in the page counts given below.** The submission of other supporting materials along with the proposals is strongly discouraged and will not be considered for review. **Full proposals, (consisting of Section II of Volume I, Technical and Management Proposal), shall not exceed 8 pages.** All full proposals must be written in English.

a. Volume I, Technical and Management Proposal

Section I. Administrative

A. Cover sheet to include:

(1) RA number (DARPA-RA-16-05);
(2) Technical topic area (proposers may only submit to ONE topic area, and salient subtopic area(s) if applicable);
(3) Lead Organization submitting proposal;
(4) Proposer's reference number (if any);
(5) Proposer's title;
(6) Technical point of contact to include: salutation, last name, first name, street address, city, state, zip code, telephone, fax (if available), electronic mail;
(7) Administrative point of contact to include: salutation, last name, first name, street address, city, state, zip code, telephone, fax (if available), electronic mail;
(8) Date proposal was submitted;
(9) Number of previous submission(s) to YFA RA(s) and submission date(s);
(10) Date of tenure-track appointment position; AND
(11) List of any and all current and past involvement with DARPA as a performer.

B. Official transmittal letter:

A transmittal letter is a standard official letter that will need to come from your institution. The contents of this letter may vary, but typically include the submission date, the solicitation announcement number, the name of the principal investigator, title of the proposed research effort, and a statement of support from the University or research institution. The transmittal letter should be on letterhead, and signed by an appropriate official from the University's Office of Sponsored Research (or equivalent). Please reach out to your University's Office of Sponsored Research for further information and guidance.

Section II. Detailed Proposal Information

A. Executive summary slide to include the following (see Attachment 1 for template format):
   - High Level Vision: What's the Big Idea/What Problem are you Solving and Who Cares?
   - Project Impact
   - Potential Department of Defense application
   - Technical Approach
   - Major Technical Risks and Risk Mitigation Strategies

B. Goals and Impact specifically address the following questions as they relate to the topic area-variants of the Heilmeier Catechism. Note each question should be recapitulated and clearly addressed within the proposal:

   (1) What are you trying to do/what big problem are you trying to solve? Objectives should be articulated using absolutely no jargon. (Note this must relate to the Technical Area that you are addressing)
   (2) What is the end goal? Who cares? This should focus on the ultimate project vision.
   (3) SOA: How is it done today, and what are the limits of current practice?
   (4) What is the new technical idea proposed? What recent discoveries support the idea or increase the likelihood of success?
   (5) What is the impact if successful? Be quantitative to the extent possible.
   (6) What is the technical approach and plan? How will the project be organized?
   (7) How will you measure progress of your work? What are the midterm and final 'exams' over the first and second years of the base period of the project to check for success?
   (8) What are the major technical challenges/risks to this project, and how will you plan to address each?
   (9) Proposed follow-on work for "Director's Fellowship": Include a short summary for proposed follow-on work if successful during the 24-month base period. If selected as a Director's Fellow the proposed follow-on work will be updated as necessary prior to the start of the 12-month option period.

C. Statement of Work (SOW) - Succinctly and clearly define the technical tasks/subtasks to be performed, their durations, and dependencies among them. Include the completion criteria for each task/activity - a product, event or milestone that defines its completion. An example template is shown below:

SOW:
Base (24 months)

Task	Description	Completion Criteria	Months
1.1			(e.g.0-24 mos)
1.2			
…			
2.1			

Option (12 months)

Task	Description	Completion Criteria	Months
1.1			(e.g.24-30 mos)
1.2			
…			
2.1			

D. Biosketch - The biosketch can include the same type of information that would appear on a CV or résumé, such as your current faculty position or title, educational background, awards received, publications and patents. DARPA leaves it up to the proposer to include the information that is most relevant to the proposal. You may use your own format for the biosketch.

Section III. Additional Information

A. A brief bibliography of relevant technical papers and research notes (published and unpublished) which document the technical ideas upon which the proposal is based.
B. Listing of past, current, and pending support, including sponsor, funding level, performance dates, and level of effort.

b. Volume II, Cost Proposal – {No Page Limit}

Cover sheet to include:

(1) RA number (DARPA-RA-16-05);
(2) Technical topic area (proposers may only submit to ONE topic area);
(3) Organization submitting proposal;
(4) Proposer's reference number (if any);
(5) Proposal title;
(6) Technical point of contact to include: salutation, last name, first name, street address, city, state, zip code, telephone, fax (if available), electronic mail (if available);
(7) Administrative point of contact to include: salutation, last name, first name, street address, city, state, zip code, telephone, fax (if available), and electronic mail (if available);
(8) Place(s) and period(s) of performance;
(9) Total proposed cost separated by basic award and option(s) (if any);
(10) Name, address, and telephone number of the proposer's cognizant Defense Contract Management Agency (DCMA) administration office (*if known)*;
(11) Name, address, and telephone number of the proposer's cognizant Defense Contract Audit Agency (DCAA) audit office (*if known*);
(12) Date proposal was prepared;
(13) DUNS number;
(14) TIN number;
(15) CAGE Code; and
(16) Proposal validity period

The Government requests and recommends that tables included in the cost proposal also be provided in MS Excel™ format with calculations formulae intact to allow traceability of the cost proposal numbers across the performer. There is no specific format and you are welcome to use your own template. If the PDF submission differs from the Excel submission, the PDF will take precedence. Each copy must be clearly labeled with the DARPA RA number, proposer organization, and proposal title (short title recommended).

The Government also requests and recommends that the Cost Proposal include MS Excel file(s) that provide traceability between the Bases of Estimate (BOEs) and the proposed costs across all elements and phases. This includes the calculations and adjustments that are utilized to generate the Summary Costs from the source labor hours, labor costs, material costs, etc. input data. The Government prefers receiving cost data as Excel files; however, this is not a requirement. There is no specific format and you are welcome to use your own template

(1) Total program cost broken down by major cost items:

a. Direct Labor – a breakout clearly identifying the individual labor categories, as established by your institution, with associated labor hours and direct labor rates;
b. Indirect Costs – Including Fringe Benefits, Overhead, General and Administrative Expense, Cost of Money, Fee, etc. (must show base amount and rate);
c. Travel – Provide the purpose of the trip, number of trips, number of days per trip, departure and arrival destinations, number of people, etc.;
d. Other Direct Costs – Itemized with costs; Back-up documentation is to be submitted to support proposed costs;
e. Material/Equipment –
   (i) A priced Bill-of-Material (BOM) clearly identifying, for each item proposed, the quantity, unit price, the source of the unit price (i.e., vendor quote, engineering estimate, etc.), the type of property (i.e., material, equipment, special test equipment, information technology, etc.), and a cross-reference to the Statement of Work (SOW) task/s that require the item/s. At time of proposal submission, any item that exceeds $1,000 must be supported with basis-of-estimate (BOE) documentation such as a copy of catalog price lists, vendor quotes or a written engineering estimate (additional documentation may be required during negotiations, if selected).
f. The source, nature, and amount of any industry cost-sharing;
g. Written justification required per Part II, Section II(A), "Fundamental Research," pertaining to effort being considered Contracted Fundamental Research; and
h. Major program tasks by month

(2) A summary of total program costs by phase (Base, Director's Fellowship Option) and calendar fiscal year;

(3) A priced Bill-of-Materials (BOM) clearly identifying, for each item proposed, the source of the unit price (i.e., vendor quote, engineering estimate, etc.) and the type of property (i.e. material, equipment, special test equipment, plant equipment, information technology (IT), for each computer hardware cost, computer software cost, and other related costs such as computer maintenance fees or support services costs (NOTE: If you propose materials, DARPA expects that you are able to defend it.);

(4) The source, nature, and amount of any industry cost-sharing. Where the effort consists of multiple portions which could reasonably be partitioned for purposes of funding, these should be identified as options with separate cost estimates for each;

(5) Identification of pricing assumptions of which may require incorporation into the resulting award instrument (e.g. use of Government Furnished Property/Facilities/Information, access to Government Subject Matter Expert(s), etc.); and

(6) A copy of the proposing organizations approved rate agreement.

PLEASE NOTE, PROPOSERS ARE CAUTIONED THAT EVALUATION RATINGS MAY BE LOWERED AND/OR PROPOSALS REJECTED IF PROPOSAL PREPARATION (PROPOSAL FORMAT, CONTENT, ETC.) AND/OR SUBMITTAL INSTRUCTIONS ARE NOT FOLLOWED.

Per Section 8123 of the Department of Defense Appropriations Act, 2015 (Division C of the Consolidated and Further Continuing Appropriations Act, 2015, Pub. L. 113-235), all grant awards must be posted on a public website in a searchable format. To facilitate this task, proposers requesting grant awards must submit a maximum one (1) page abstract that may be publicly posted to comply with the requirement of Section 8123. This abstract should explain the project or program to the public and should only contain information that the proposer confirms is releasable to the public; DO NOT INCLUDE ANY PROPRIETARY INFORMATION OR INFORMATION THAT CANNOT BE DISPLAYED ON A PUBLIC WEBSITE. The proposer should sign the bottom of the abstract confirming the information in the abstract is approved for public release. Proposers are advised to provide both a signed PDF copy, as well as an editable (e.g., Microsoft word) copy. Abstracts contained in grant proposals that are not selected for award will not be publicly posted.

5. Submission Dates and Times

a. Full Proposal Date

The full proposal must be submitted to DARPA Grants.gov on or before 4:00 PM., Eastern Time, April 5, 2016, in order to be considered during the single round of selections. Proposals received after this deadline will not be reviewed.

DARPA will post on a regular basis a consolidated Question and Answer (FAQ) document. To access the posting go to: http://www.darpa.mil/work-with-us/opportunities (the BTO office solicitations page) and look for "DARPA-RA-16-05." The FAQ will be posted in a PDF download under the brief description of the funding opportunity. Submit your question/s by E-mail to DARPA-RA-16-05@darpa.mil. In order to receive a response sufficiently in advance of the proposal due date, send your question/s on or before 4:00 PM, Eastern Time, March 24, 2016.

DARPA will acknowledge receipt of complete submissions via email and assign control numbers that should be used in all further correspondence regarding proposals.

6. Funding Restrictions

The RA seeks proposals for a research activity consisting of a 24-month base period with a maximum funding level of $500,000 including all direct and indirect costs. For exceptional YFA project performance over the 24-month base period, a limited number of YFA performers will be awarded a "Director's Fellowship" with a maximum of an additional $500,000 in follow-on funding for an additional estimated 12-month period.

7. Other Submission Requirements

All proposals should clearly indicate limitations on the disclosure of their contents. Proposers who include in their proposals data that they do not want disclosed to the public for any purpose, or used by the Government except for evaluation purposes, shall do the following:

> (1) Mark the title page with the following legend: This proposal includes data that shall not be disclosed – in whole or in part – for any purpose other than to evaluate this proposal. If, however, a contract is awarded to this proposer as a result of, or in connection with, the submission of this data, the Government shall have the right to duplicate, use, or disclose the data to the extend provided in the resulting contract. This restriction does not limit the Government's right to use information contained in this data if it is obtained from another source without restriction; and
> (2) Mark each sheet of data they wish to restrict with the following legend: Use or disclosure of data contained on this sheet is subject to the restriction on the title page of this proposal.

Markings such as "Company Confidential" or other phrases that may be confused with national security classifications should be avoided. The proposer may be required to remove such markings before the proposal will be accepted. "Proprietary" or "Company Proprietary" are acceptable notations.

Sec. V: APPLICATION REVIEW INFORMATION

A. Evaluation Criteria

Proposals will be evaluated using the following criteria, listed in descending order of importance: (a) Overall Scientific and Technical Merit; (b) Potential Contribution and Relevance to the DARPA Mission; and (c) Cost Realism.

(a) Overall Scientific and Technical Merit

The proposed technical approach is feasible, achievable, complete and supported by a proposed technical team that has the expertise and experience to accomplish the proposed tasks. Task descriptions and associated technical elements provided are complete and in a logical sequence with all proposed deliverables clearly defined such that a final outcome that achieves the goal can be expected as a result of award. The proposal identifies major technical risks and planned mitigation efforts are clearly defined and feasible.

(b) Potential Contribution and Relevance to the DARPA Mission

The potential contributions of the proposed effort are relevant to the national technology base. Specifically, DARPA's mission is to maintain the technological superiority of the U.S. military and prevent technological surprise from harming national security by sponsoring revolutionary, high-payoff research that bridges the gap between fundamental discoveries and their application.

(c) Cost Realism

The proposed costs are realistic for the technical and management approach and accurately reflect the technical goals and objectives of the solicitation. The proposed costs are consistent with the proposer's Statement of Work and reflect a sufficient understanding of the costs and level of effort needed to successfully accomplish the proposed technical approach. The costs for the prime proposer are substantiated by the details provided in the proposal (e.g., the type and number of labor hours proposed per task, the types and quantities of materials, equipment and fabrication costs, travel and any other applicable costs). It is expected that the effort will leverage all available relevant prior research in order to obtain the maximum benefit from the available funding. DARPA recognizes that undue emphasis on cost may motivate proposers to offer low-risk ideas with minimum uncertainty and to staff the effort with junior personnel in order to be in a more competitive posture. DARPA discourages such cost strategies.

B. Review and Selection Process

DARPA will conduct a scientific/technical review of each conforming proposal. Proposals will not be evaluated against each other since they are not submitted in accordance with a common work statement. DARPA's intent is to review proposals as soon as possible after they arrive; however, proposals may be reviewed periodically for administrative reasons.

Award(s) will be made to proposers whose proposals are determined to be the most advantageous to the Government, all factors considered, including the potential contributions of the proposed work to the overall research program and the availability of funding for the effort.

It is the policy of DARPA to ensure impartial, equitable, comprehensive proposal evaluations and to select the source (or sources) whose offer meets the Government's technical, policy, and programmatic goals. Pursuant to FAR 35.016, the primary basis for selecting proposals for acceptance shall be technical, importance to agency programs, and fund availability. In order to provide the desired evaluation, qualified Government personnel will conduct reviews and (if necessary) convene panels of experts in the appropriate areas.

For evaluation purposes, a proposal is the document described in "Proposal Information", Section IV.B. Other supporting or background materials submitted with the proposal will be considered for the reviewer's convenience only and not considered as part of the proposal.

Restrictive notices notwithstanding, proposals may be handled for administrative purposes by support contractors. These support contractors are prohibited from competition in DARPA technical research and are bound by appropriate non-disclosure requirements.

Subject to the restrictions set forth in FAR 37.203(d), input on technical aspects of the proposals may be solicited by DARPA from non-Government consultants/experts who are strictly bound by the appropriate non-disclosure requirements.

Sec. VI: AWARD ADMINISTRATION INFORMATION

A. Selection Notices

As soon as the evaluation of a proposal is complete, the proposer will be notified that (1) the proposal has been selected for funding pending contract negotiations, or (2) the proposal has not been selected. These official notifications will be sent via email to the Technical POC identified on the proposal coversheet.

B. Administrative and National Policy Requirements

1. Meeting and Travel Requirements

There will be a program kickoff meeting and all key participants are required to attend. In addition, during the 24-month base period, a number of visits/exercises at a variety of DoD sites and facilities will be scheduled. Participation in all such opportunities is not required, however lack of participation may impact the award of the Director's Fellowship. Proposers are expected to include funds for two program review meetings and at least one three-day military visit within the total budget of their proposal.

2. Human Subjects Research

All research selected for funding involving human subjects, to include use of human biological specimens and human data, must comply with the federal regulations for human subject protection. Further, research involving human subjects that is conducted or supported by the DoD must comply with 32 CFR 219, *Protection of Human Subjects* (and DoD Directive 3216.02, *Protection of Human Subjects and Adherence to Ethical Standards in DoD-Supported Research)* (http://www.dtic.mil/whs/directives/corres/pdf/321602p.pdf).

Institutions awarded funding for research involving human subjects must provide documentation of a current Assurance of Compliance with Federal regulations for human subject protection, such as a Department of Health and Human Services, Office of Human Research Protection Federal Wide Assurance (http://www.hhs.gov/ohrp). All institutions engaged in human subject research must also hold a valid Assurance. In addition, all personnel involved in human subjects research must provide documentation of completion of human subjects research training.

For all proposed research that will involve human subjects in the first year or phase of the project, the institution must provide evidence of or a plan for review by an Institutional Review Board (IRB) upon final proposal submission to DARPA as part of their proposal, prior to being selected for funding. The IRB conducting the review must be the IRB identified on the institution's Assurance of Compliance with human subjects protection regulations. The protocol, separate from the proposal, must include a detailed description of the research plan, study population, risks and

benefits of study participation, recruitment and consent process, data collection, and data analysis. It is recommended that you consult the designated IRB for guidance on writing the protocol. The informed consent document must comply with federal regulations (32 CFR 219.116). A valid Assurance of Compliance with human subjects protection regulations along with evidence of completion of appropriate human subjects research training by all investigators and personnel involved with human subjects research should accompany the protocol for review by the IRB.

In addition to a local IRB approval, a headquarters-level human subjects administrative review and approval is required for all research conducted or supported by the DoD. The Army, Navy, or Air Force office responsible for managing the award can provide guidance and information about their component's headquarters-level review process. Note that confirmation of a current Assurance of Compliance with human subjects protection regulations and appropriate human subjects protection training is required before headquarters-level approval can be issued.

The time required to complete the IRB review/approval process varies depending on the complexity of the research and the level of risk involved with the study. The IRB approval process can last between one to three months, followed by a DoD review that could last between three and six months. Ample time should be allotted to complete the approval process. DoD/DARPA funding cannot be used towards human subjects research until ALL approvals are granted.

3. Animal Use

Award recipients performing research, experimentation, or testing involving the use of animals shall comply with the rules on animal acquisition, transport, care, handling, and use as outlined in: (i) 9 CFR parts 1-4, Department of Agriculture rules that implement the Animal Welfare Act of 1966, as amended, (7 U.S.C. § 2131-2159); (ii) National Institutes of Health Publication No. 86-23, "Guide for the Care and Use of Laboratory Animals" (8th Edition); (iii) DoD Instruction 3216.01, "Use of Animals in DoD Programs."

For projects anticipating animal use, proposals should briefly describe plans for Institutional Animal Care and Use Committee (IACUC) review and approval. Animal studies in the program will be expected to comply with the Public Health Service (PHS) Policy on Humane Care and Use of Laboratory Animals, available at http://grants.nih.gov/grants/olaw/olaw.htm.

All award recipients must receive approval by a DoD-certified veterinarian, in addition to an IACUC approval. No animal studies may be conducted using DoD/DARPA funding until the United States Army Medical Research and Materiel Command (USAMRMC) Animal Care and Use Review Office (ACURO) or other appropriate DoD veterinary office(s) grant approval. As a part of this secondary review process, the award recipient will be required to complete and submit an ACURO Animal Use Appendix, which may be found at https://mrmc-www.army.mil/index.cfm?pageid=Research_Protections.acuro&rn=1.

4. Export Control

Per DFARS 225.7901-4, all procurement contracts, other transactions and other awards, as deemed appropriate, resultant from this solicitation will include the DFARS Export Control clause (252.225-7048).

5. Subcontracting

This RA solicits single-investigator proposals only. The RA prohibits subcontracting or co-principal investigator(s). Additional faculty members may only be included in a supporting role. It is up to the applicant to structure his or her research team in a way that best supports the research goals. Applicants are strongly encouraged to discuss their YFA submission with their Office of Sponsored Research (or equivalent) several weeks in advance of the submission deadline.

6. Electronic and Information Technology

All electronic and information technology acquired through this solicitation must satisfy the accessibility requirements of Section 508 of the Rehabilitation Act (29 U.S.C. § 794d) and FAR 39.2. Each proposer who submits a proposal involving the creation or inclusion of electronic and information technology must ensure that federal employees with disabilities will have access to and use of information that is comparable to the access and use by Federal employees who are not individuals with disabilities and members of the public with disabilities seeking information or services from DARPA will have access to and use of information and data that is comparable to the access and use of information and data by members of the public who are not individuals with disabilities.

7. System for Award Management (SAM) Registration and Universal Identifier Requirements

Unless the proposer is exempt from this requirement, as per FAR 4.1102 or 2 CFR 25.110 as applicable, all proposers must be registered in the System for Award Management (SAM) and have a valid Data Universal Numbering System (DUNS) number prior to submitting a proposal. All proposers must maintain an active registration in SAM with current information at all times during which they have an active Federal award or proposal under consideration by DARPA. All proposers must provide the DUNS number in each proposal they submit.

Information on SAM registration is available at https://www.sam.gov/portal/SAM/.

8. Reporting Executive Compensation and First-Tier Subcontract Awards

FAR clause 52.204-10, "Reporting Executive Compensation and First-Tier Subcontract Awards," will be used in all procurement contracts valued at $25,000 or more. A similar award term will be used in all grants and cooperative agreements.

9. Representation by Corporations Regarding an Unpaid Delinquent Tax Liability or a Felony Conviction under any Federal Law

The following representation will be included in all awards:

(a) In accordance with sections 744 and 745 of Division E, Title VII, of the Consolidated and Further Continuing Appropriations Act, 2015 (Pub. L. 11-235), none of the funds made available by this or any other Act may be used to enter into a contract with any corporation that —

(1) Has any unpaid Federal tax liability that has been assessed, for which all judicial and administrative remedies have been exhausted or have lapsed, and that is not being paid in a timely manner pursuant to an agreement with the authority responsible for collecting the tax liability, where the awarding agency is aware of the unpaid tax liability, unless the agency has considered suspension or debarment of the corporation and made a determination that this further action is not necessary to protect the interests of the Government; or

(2) Was convicted of a felony criminal violation under any Federal law within the preceding 24 months, where the awarding agency is aware of the conviction, unless the agency has considered suspension or debarment of the corporation and made a determination that this action is not necessary to protect the interests of the Government.

(b) The Offeror represents that –

(1) It is [ ] is not [ ] a corporation that has any unpaid Federal tax liability that has been assessed, for which all judicial and administrative remedies have been exhausted or have lapsed, and that is not being paid in a timely manner pursuant to an agreement with the authority responsible for collecting the tax liability,

(2) It is [ ] is not [ ] a corporation that was convicted of a felony criminal violation under a Federal law within the preceding 24 months.

10. Controlled Unclassified Information (CUI) on Non-DoD Information Systems

Controlled Unclassified Information (CUI) refers to unclassified information that does not meet the standards for National Security Classification but is pertinent to the national interests of the United States or to the important interests of entities outside the Federal Government and under law or policy requires protection from unauthorized disclosure, special handling safeguards, or prescribed limits on exchange or dissemination. All non-DoD entities doing business with DARPA are expected to adhere to the following procedural safeguards, in addition to any other relevant Federal or DoD specific procedures, for submission of any proposals to DARPA and any potential business with DARPA:

Do not process DARPA CUI on publicly available computers or post DARPA CUI to publicly available webpages or websites that have access limited only by domain or Internet protocol restriction.

Ensure that all DARPA CUI is protected by a physical or electronic barrier when not under direct individual control of an authorized user and limit the transfer or DARPA CUI to subcontractors or teaming partners with a need to know and commitment to this level of protection.

Ensure that DARPA CUI on mobile computing devices is identified and encrypted and all communications on mobile devices or through wireless connections are protected and encrypted.

Overwrite media that has been used to process DARPA CUI before external release or disposal.

11. Safeguarding of Unclassified Controlled Technical Information

Per DFARS 204.7303, DFARS 252.204-7012, Safeguarding of Unclassified Controlled Technical Information, applies to this solicitation and all FAR-based awards resulting from this solicitation.

12. Prohibition on Contracting with Entities that Require Certain Internal Confidentiality Agreements

(a) In accordance with section 743 of Division E, Title VII, of the Consolidated and Further Continuing Resolution Appropriations Act, 2015 (Pub. L. 113-235), Government agencies are not permitted to use funds appropriated (or otherwise made available) under that or any other Act for contracts with an entity that requires employees or subcontractors of such entity seeking to report fraud, waste, or abuse to sign internal confidentiality agreements or statements prohibiting or otherwise restricting such employees or contactors from lawfully reporting such waste, fraud, or abuse to a designated investigative or law enforcement representative of a Federal department or agency authorized to receive such information.

(b) The prohibition in paragraph (a) of this provision does not contravene requirements applicable to Standard Form 312, Form 4414, or any other form issued by a Federal department or agency governing the nondisclosure of classified information.

(c) *Representation*. By submission of its offer, the Offeror represents that it does not require employees or subcontractors of such entity seeking to report fraud, waste, or abuse to sign or comply with internal confidentiality agreements or statements prohibiting or otherwise restricting such employees or contactors from lawfully reporting such waste, fraud, or abuse to a designated investigative or law enforcement representative of a Federal department or agency authorized to receive such information.

C. Reporting

The number and types of reports will be specified in the award document, but will include as a minimum [monthly/quarterly] financial status reports. The reports shall be prepared and submitted in accordance with the procedures contained in the award document and mutually agreed on before award. Reports and briefing material will also be required as appropriate to document progress in accomplishing program metrics. A Final Report that summarizes the project and tasks will be required at the conclusion of the performance period for the award, notwithstanding the fact that the research may be continued under a follow-on vehicle.

D. Electronic Systems

1. Representations and Certifications

Accepted proposers are required to complete representations and certifications as presented by the grants officer after selection.

2. Wide Area Work Flow (WAWF)

Unless using another means of invoicing, performers will be required to submit invoices for payment directly via to http://wawf.eb.mil. Registration in WAWF will be required prior to any award under this RA.

3. i-Edison

The award document for each proposal selected for funding will contain a mandatory requirement for patent reports and notifications to be submitted electronically through i-Edison (http://s-edison.info.nih.gov/iEdison) .

Sec. VII: AGENCY CONTACTS

Administrative, technical or contractual questions should be sent via e-mail to DARPA-RA-16-05@darpa.mil. All requests must include the name, email address, and phone number of a point of contact.

The technical POC for this effort is:

Dr. Justin Gallivan
DARPA/BTO
ATTN: DARPA-RA-16-05
675 North Randolph Street
Arlington, VA 22203-2114

Email: DARPA-RA-16-05@darpa.mil

Sec. VIII: OTHER INFORMATION

A. Intellectual Property

1. Data Rights Restrictions

Proposers responding to this RA shall appropriately identify any potential restrictions on the Government's use of any Intellectual Property contemplated under the resulting award. This includes both Noncommercial Items and Commercial Items. The Government may use the list during the evaluation process to evaluate the impact of any identified restrictions, and may request additional information from the proposer, as may be necessary, to evaluate the proposer's assertions. If no restrictions are intended, then the proposer should state "NONE." Failure to provide full information

may result in a determination that the proposal is not compliant with the RA – resulting in nonselectability of the proposal.

A sample list for complying with this request is as follows:

DATA RIGHTS ASSERTIONS				
Technical Data Computer Software to be Furnished With Restrictions	Summary of Intended Use in the Conduct of the Research	Basis for Assertion	Asserted Rights Category	Name of Person Asserting Restrictions
(LIST)	(NARRATIVE)	(LIST)	(LIST)	(LIST)

2. Patents

Include documentation proving your ownership of or possession of appropriate licensing rights to all patented inventions (or inventions for which a patent application has been filed) that will be utilized under your proposal for the DARPA program. If a patent application has been filed for an invention that your proposal utilizes, but the application has not yet been made publicly available and contains proprietary information, you may provide only the patent number, inventor name(s), assignee names (if any), filing date, filing date of any related provisional application, and a summary of the patent title, together with either: (1) a representation that you own the invention, or (2) proof of possession of appropriate licensing rights in the invention.

3. Intellectual Property Representations

Provide a good faith representation that you either own or possess appropriate licensing rights to all other intellectual property that will be utilized under your proposal for the DARPA program.