Office of the Secretary Of Defense (OSD)
Deputy Director of Defense Research & Engineering
Deputy Under Secretary of Defense (Science & Technology)
Small Business Innovation Research (SBIR)
FY2009.1 Program Description

Introduction

The Deputy Under Secretary of Defense (Science & Technology) SBIR Program is sponsoring the Defense Health Program Biomedical Technology theme, and the Intrinsically Corrosion Resistant Technology theme in this solicitation.

The Army and Navy are participating in the OSD SBIR Program this year. The service laboratories act as our OSD Agent in the management and execution of the contracts with small businesses. The service laboratories, often referred to as a DoD Component acting on behalf of the OSD, invite small business firms to submit proposals under this Small Business Innovation Research (SBIR) Program solicitation. In order to participate in the OSD SBIR Program this year, all potential proposers should register on the DoD SBIR Web site as soon as you can, and should follow the instruction for electronic submittal of proposals. It is required that all bidders submit their proposal cover sheet, company commercialization report and their firm's technical and cost proposal form electronically through the DoD SBIR/STTR Proposal Submission Web site at http://www.dodsbir.net/submission. If you experience problems submitting your proposal, call the help desk (toll free) at 1-866-724-7457. You must include a Company Commercialization Report as part of each proposal you submit; however, it does not count against the proposal page limit of 25 pages. Please note that improper handling of this form may result in the proposal being substantially delayed. Information provided may have a direct impact on the review of the proposal. The DoD SBIR Proposal Submission Web site allows your company to come in any time (prior to the proposal submission deadline) to edit your Cover Sheets, Technical and Cost Proposal and Company Commercialization Report.

We WILL NOT accept any proposals that are not submitted through the on-line submission site. The submission site does not limit the overall file size for each electronic proposal, there is only a 25-page limit. However, file uploads may take a great deal of time depending on your file size and your internet server connection speed. If you wish to upload a very large file, it is highly recommended that you submit prior to the deadline submittal date, as the last day is heavily trafficked. You are responsible for performing a virus check on each technical proposal file to be uploaded electronically. The detection of a virus on any submission may be cause for the rejection of the proposal. We will not accept e-mail submissions.

Firms with strong research and development capabilities in science or engineering in any of the topic areas described in this section and with the ability to commercialize the results are encouraged to participate. Subject to availability of funds, the DUSD(S&T) SBIR Program will support high quality research and development proposals of innovative concepts to solve the listed defense-related scientific or engineering problems, especially those concepts that also have high potential for commercialization in the private sector. Objectives of the DUSD(S&T) SBIR Program include stimulating technological innovation, strengthening the role of small business in meeting DoD research and development needs, fostering and encouraging participation by minority and disadvantaged persons in technological innovation, and increasing the commercial application of DoD-supported research and development results. The guidelines presented in the solicitation incorporate and exploit the flexibility of the SBA Policy Directive to encourage proposals based on scientific and technical approaches most likely to yield results important to DoD and the private sector.

Description of the OSD SBIR Three Phase Program

Phase I is to determine, insofar as possible, the scientific or technical merit and feasibility of ideas submitted under the SBIR Program and will typically be one half-person year effort over a period not to exceed six months, with a dollar value up to $100,000. We plan to fund 3 Phase I contracts, on average, and down-select to one Phase II contract per topic. This is assuming that the proposals are sufficient in quality to fund this many. Proposals should concentrate on that research and development which will significantly contribute to proving the scientific and technical feasibility of the proposed effort, the successful completion of which is a prerequisite for further DoD support in Phase II. The measure of Phase I success includes technical performance toward the topic objectives and evaluations of the extent to which Phase II results would have the potential to yield a product or process of continuing importance to DoD and the private sector, in accordance with Section 4.3.

Subsequent Phase II awards will be made to firms on the basis of results from the Phase I effort and the scientific and technical merit of the Phase II proposal in addressing the goals and objectives described in the topic. Phase II awards will typically cover 2 to 5 person-years of effort over a period generally not to exceed 24 months (subject to negotiation). Phase II is the principal research and development effort and is expected to produce a well defined deliverable prototype or process. A more comprehensive proposal will be required for Phase II.

Under Phase III, the DoD may award non-SBIR funded follow-on contracts for products or processes, which meet the Component mission needs. This solicitation is designed, in part, to encourage the conversion of federally sponsored research and development innovation into private sector applications. The small business is expected to use non-federal capital to pursue private sector applications of the research and development.

This solicitation is for Phase I proposals only. Any proposal submitted under prior SBIR solicitations will not be considered under this solicitation; however, offerors who were not awarded a contract in response to a particular topic under prior SBIR solicitations are free to update or modify and submit the same or modified proposal if it is responsive to any of the topics listed in this section.

For Phase II, no separate solicitation will be issued and no unsolicited proposals will be accepted. Only those firms that were awarded Phase I contracts, and have successfully completed their Phase I efforts, will be invited to submit a Phase II proposal. Invitations to submit Phase II proposals will be released at or before the end of the Phase I period of performance. The decision to invite a Phase II proposal will be made based upon the success of the Phase I contract to meet the technical goals of the topic, as well as the overall merit based upon the criteria in section 4.3. DoD is not obligated to make any awards under Phase I, II, or III. DoD is not responsible for any money expended by the proposer before award of any contract. For specifics regarding the evaluation and award of Phase I or II contracts, please read the front section of this solicitation very carefully. Every Phase II proposal will be reviewed for overall merit based upon the criteria in section 4.3 of this solicitation, repeated below:

a. The soundness, technical merit, and innovation of the proposed approach and its incremental progress toward topic or subtopic solution.
b. The qualifications of the proposed principal/key investigators, supporting staff, and consultants. Qualifications include not only the ability to perform the research and development but also the ability to commercialize the results.
c. The potential for commercial (defense and private sector) application and the benefits expected to accrue from this commercialization.

In addition, the OSD SBIR Program has a Phase II Plus Program, which provides matching SBIR funds to expand an existing Phase II contract that attracts investment funds from a DoD acquisition program, a non-SBIR/non-STTR government program or Private sector investments. Phase II Plus allows for an existing Phase II OSD SBIR contract to be extended for up to one year per Phase II Plus application, to perform additional research and development. Phase II Plus matching funds will be provided on a one-for-one basis up to a maximum $500,000 of SBIR funds. All Phase II Plus awards are subject to acceptance, review, and selection of candidate projects, are subject to availability of funding, and successful negotiation and award of a Phase II Plus contract modification. The funds provided by the DoD acquisition program or a non-SBIR/non-STTR government program must be obligated on the OSD Phase II contract as a modification prior to or concurrent with the OSD SBIR funds. Private sector funds must be deemed an “outside investor” which may include such entities as another company, or an investor. It does not include the owners or family members, or affiliates of the small business (13 CFR 121.103).

The Fast Track provisions in section 4.0 of this solicitation apply as follows. Under the Fast Track policy, SBIR projects that attract matching cash from an outside investor for their Phase II effort have an opportunity to receive interim funding between Phases I and II, to be evaluated for Phase II under an expedited process, and to be selected for Phase II award provided they meet or exceed the technical thresholds and have met their Phase I technical goals, as discussed Section 4.5. Under the Fast Track Program, a company submits a Fast Track application, including statement of work and cost estimate, within 120 to 180 days of the award of a Phase I contract (see the Fast Track Application Form on www.dodsbir.net/submission). Also submitted at this time is a commitment of third party funding for Phase II. Subsequently, the company must submit its Phase I Final Report and its Phase II proposal no later than 210 days after the effective date of Phase I, and must certify, within 45 days of being selected for Phase II award, that all matching funds have been transferred to the company. For projects that qualify for the Fast Track (as discussed in Section 4.5), DoD will evaluate the Phase II proposals in an expedited manner in accordance with the above criteria, and may select these proposals for Phase II award provided: (1) they meet or exceed selection criteria (a) and (b) above and (2) the project has substantially met its Phase I technical goals (and assuming budgetary and other programmatic factors are met, as discussed in Section 4.1). Fast Track proposals, having attracted matching cash from an outside investor, presumptively meet criterion (c). However, selection and award of a Fast Track proposal is not mandated and DoD retains the discretion not to select or fund any Fast Track proposal.

Follow-On Funding

In addition to supporting scientific and engineering research and development, another important goal of the program is conversion of DoD-supported research and development into commercial (both Defense and Private Sector) products. Proposers are encouraged to obtain a contingent commitment for follow-on funding prior to Phase II where it is felt that the research and development has commercialization potential in either a Defense system or the private sector. Proposers who feel that their research and development have the potential to meet Defense system objectives or private sector market needs are encouraged to obtain either non-SBIR DoD follow-on funding or non-federal follow-on funding, for Phase III to pursue commercialization development. The commitment should be obtained during the course of Phase I performance, or early in the Phase II performance. This commitment may be contingent upon the DoD supported development meeting some specific technical objectives in Phase II which if met, would justify funding to pursue further development for commercial (either Defense related or private sector) purposes in Phase III. The recipient will be permitted to obtain commercial rights to any invention made in either Phase I or Phase II, subject to the patent policies stated elsewhere in this solicitation.

Contact with DoD

General informational questions pertaining to proposal instructions contained in this solicitation should be directed to the topic authors and point of contact identified in the topic description section. Proposals should be electronically submitted. Oral communications with DoD personnel regarding the technical content of this solicitation during the pre-solicitation phase are allowed, however, proposal evaluation is conducted only on the written submittal. Oral communications during the pre-solicitation period should be considered informal, and will not be factored into the selection for award of contracts. Oral communications subsequent to the pre-solicitation period, during the Phase I proposal preparation periods are prohibited for reasons of competitive fairness. Refer to the front section of the solicitation for the exact dates.

Proposal Submission

Proposals shall be submitted in response to a specific topic identified in the following topic description sections. The topics listed are the only topics for which proposals will be accepted. Scientific and technical information assistance may be requested by using the SBIR/STTR Interactive Technical Information System (SITIS).

It is required that all bidders submit their proposal cover sheet, company commercialization report and their firm's technical and cost proposal form electronically through the DoD SBIR/STTR Proposal Submission Web site at http://www.dodsbir.net/submission. If you experience problems submitting your proposal, call the help desk (toll free) at 866-724-7457. You must include a Company Commercialization Report as part of each proposal you submit; however, it does not count against the proposal page limit of 25 pages. Please note that improper handling of this form may result in the proposal being substantially delayed. Information provided may have a direct impact on the review of the proposal. The proposal submission Web site allows your company to come in any time (prior to the proposal submission deadline) to edit your Cover Sheets, Technical and Cost Proposal and Company Commercialization Report. We **WILL NOT accept any proposals which are not submitted through the on-line submission site.** The submission site does not limit the overall file size for each electronic proposal, only the number of pages is limited. However, file uploads may take a great deal of time depending on your file size and your internet server connection speed. You are responsible for performing a virus check on each technical proposal file to be uploaded electronically. The detection of a virus on any submission may be cause for the rejection of the proposal. We will not accept e-mail submissions.

The following pages contain a summary of the technology focus areas, which are followed by the topics.

Defense Health Program Biomedical Technology Focus Area

The Department of Defense is aggressively pursuing unified Force Health Protection and Deployment Health strategies to protect Service members and their families from health hazards associated with military service. Toward that end, DoD is undertaking technology development programs that save lives and promote healthy individuals, units and communities while improving both force morale and warfighting capabilities.

The operational force is exposed to health threats throughout the operational continuum, from CONUS fixed facilities (garrison, base, ashore) through deployment, employment, and redeployment. DoD is developing policy and procedures to assess occupational and environmental health threats for all locations.

When Force Health Protection capabilities are fully implemented, commanders will have a more complete view of potential health threats. Integration of assessments from health databases and other assessments from intelligence (e.g., about land mines, directed enemy fire, fratricide) and safety (e.g., about injuries, vehicle accidents, explosives, aviation mishaps) will provide a framework for identifying future medical technology capabilities necessary for Force Health Protection.

Ensuring the health of the force encompasses several key capabilities:

- To mobilize, deploy and sustain medical and health support for any operation requiring military services;
- To maintain and project the continuum of healthcare resources required to provide for the health of the force;
- To operate in conjunction with beneficiary healthcare; and
- To develop training systems which provide realistic rehearsal of emergency medical and surgical procedures and unit-level medical operations.

These capabilities comprise an integrated and focused approach to protect and sustain DoD's most important resource—its Service members and their families—throughout the entire length of service commitment.

The Office of the Secretary of Defense believes that the small-business community can be effective in developing new technology-based approaches to needs in force health protection. Three broad capability areas of particular interest are tools and techniques for near real-time surveillance of the health threats and health status of the Force, for epidemiology research, and for delivery of health education and training. These are described in more detail below:

- Health Surveillance Planning and Decision Support Tools: Tailorable and targeted software applications that are integrated into the Military Health System's backbone of installed information systems are the essential enabling technology for surveillance. Applications in the areas of decision support tools, data and knowledge management, information visualization technologies including geospatial tools, and artificial intelligence-based appliqués for essential analyses are needed. It is expected that the applications would produce a comprehensive system of risk based assessments, predictions, and courses-of-action utilizing epidemiological, intelligence, environmental exposure, and health information concerning deployed forces. The applications should also allow for predictive modeling of medical readiness scaleable from individuals to the aggregated Force, given such data streams as reported real and somatic symptoms.

- New Methods to Monitor Health Status and Clinical Laboratory Data: Monitoring of health status during deployments is necessary to determine etiologic factors of deployment related health change. Data and information analysis tools are needed to collect and harmonize disparate data and information sources and to provide health status surveillance pre- or post-injury to medical information consumers within and outside of military medical channels. Health monitoring should be for a limited set of indicators, and should yield an unambiguous interpretation of health status. Projects are required to have a strong biological basis and be sensitive to changes in health status based on either real-time measurements from warfighters in an operational environment, clinical laboratory data sources, and/or recorded in-patient or out-patient or trauma registry data.

- Medical Training and Learning Tools: Developing and maintaining skills among the personnel of the Military Health System is an important aspect of deployment health. Advanced distributed learning, simulation-based training and other computer-based training technology should enable all health-care personnel to plan, respond and manage the future medical missions, and should assist medical professionals to maintain clinical knowledge and skills. Tools that can be extended to use by the general military population for proactive preventive medicine are desirable. Tools should be based on existing medical and allied health knowledge, should be universally accessible, should allow for unlimited practice, and should be SCORM-compliant in content and in delivery modalities.

The Defense Health Program Biomedical Technology topics are:

OSD09-H01	Cognitive/Motor Therapy Application Using Console-Based Videogame Platform (Army)
OSD09-H02	Non Invasive Assessment of Intracranial Pressure and Cerebrovascular Status after Traumatic Brain Injury (Army)
OSD09-H03	Virtual Dialogue Application for Families of Deployed Service Members (Army)
OSD09-H04	Development of Virtual Reality Tools for Assessment of Return-to-Duty Status following Mild Traumatic Brain Injury (mTBI) (Army)
OSD09-H05	Utilization of Affective Computing for Cognitive and Physical Rehabilitation of Victims of Traumatic Brain Injury (Army)

Intrinsically Corrosion Resistant Technology Focus Area

The cost of corrosion for DoD is between $10 -$20B per year DoD. The cost of corrosion to the DoN has been estimated at $4.4B per year. The impact of corrosion on Defense aviation is huge. As an example, over 100 million work hours and nearly $1 billion have been spent by the Naval Air Systems Command from 1994 to 2004 on corrosion related problems. Further it is important to understand that the financial impact of corrosion is just one aspect of corrosion's pernicious effects. Corrosion also affects safety and the number of aircraft ready for tasking.

Advanced paint, sealants, corrosion prevention compounds have been employed in order to mitigate the effects of corrosion. Improved maintenance and system designs have reduced corrosion related problems. Little work, however, has been focused on the research, development, and transition materials and structures that are intrinsically corrosion resistant. When a paint or sealant applied to a structural material is breached or applied in a less than a perfect manner, the material is exposed to the harsh naval environment. The material will corrode and the mechanical properties of the Component will degrade.

Focused areas of innovative research and development are requested that address the broad technical challenges associated with developing intrinsically corrosion resistant alloys. It is envisioned that nascent and emerging design-of-materials concepts will be matured and developed including a) multi-scale computational modeling and simulation; b) mechanistic understanding of fundamental physical and chemical interactions; and c) materials thermo-physical data and thermodynamic phase stability.

The Intrinsically Corrosion Resistant Technology topics are:

OSD09-C01	Corrosion Resistant Naval Alloys: Innovative Multi-Scale Computational Modeling and Simulation Tools (Navy)
OSD09-C02	Innovative Methodologies for the Development of a High Strength, Anodize-Free Corrosion Resistant, Aerospace Aluminum Alloys (Navy)
OSD09-C03	Highly Corrosion Resistant Aluminum Alloys: Innovative Processing Methods to Enhanced Corrosion Resistance (e.g., layered structures, etc.) (Navy)
OSD09-C04	Innovative Approaches for the Development of Ultra-High Strength Intrinsically Corrosion Resistant Steel (Navy)
OSD09-C05	Innovative Concepts for Rapid and Inexpensive Testing for Threshold Stress Intensity (KISCC) under Stress Corrosion Cracking (SCC) Conditions of Aluminum Alloys (Navy)

OSD SBIR 091 Topic Index

OSD SBIR 091 Topic Descriptions

OSD09-C01 TITLE: Corrosion Resistant Naval Alloys: Innovative Multi-Scale Computational Modeling and Simulation Tools

TECHNOLOGY AREAS: Materials/Processes

OBJECTIVE: Develop an integrated set of multi-scale modeling and simulation tools for the development corrosion resistant alloys.

DESCRIPTION: The cost of corrosion for DoD is between $10-$20B per year. The impact of corrosion on naval aviation is huge. Over 100 million work hours and approximately $5.4 billion/yr is spent on corrosion related maintenance of naval aviation aircraft and ships. Advanced multi-scale computational tools are required in order to enable physical and chemical mechanisms, occurring at the atomic through macroscopic size ranges, to be related to macroscopic material properties. The integration of computational tools (e.g., microstructural, process, mechanistic, cost) is essential in order to fully enable alloy by design.

PHASE I: Conceptual design of a multi-scale computational tool capable of correctly predicting mechanical and corrosion properties based upon an alloy's microstructure and processing history. Demonstrate the feasibility of the conceptual design by applying the tool to the laboratory scale production of a potential aerospace alloy and testing the mechanical and corrosion properties of specimen coupons.

PHASE II: Provide practical implementation of the computational alloy design tool developed under Phase I. Evaluate the approach through the design, production, and testing of one or more high-strength, corrosion resistant, aerospace alloys.

PHASE III DUAL-USE APPLICATIONS: Transition the approach to the production of an aircraft or ship alloy. The ability to design alloys for the optimal combination of mechanical properties and corrosion resistance should have wide-spread commercial and DoD applications, e.g., in the aerospace and marine ship building industry.

REFERENCES:
1. William E. Frazier, "Corrosion-Resistant Alloys for Naval Aviation," Advanced Materials & Process. March 2007

2. David A. Forman, Eric F. Herzberg, James C. Tran, Amelia R. Kelly, Paul N. Chang, Norman T. O'Meara, Ph.D., "The Annual Cost of Corrosion for Navy and Marine Corps Aviation Equipment" (LMI Government Consulting, Report MEC70T3, May 2008). Draft.

3. John Aidun, et al., "Towards Enhancing Sandia's Capabilities in Multiscale Materials Modeling and Simulation," (SAND2004-0155, Sandia National Laboratories, January 2004)

4. S. Serebrinskya, E.A. Carterb, M. Ortiza, "A quantum-mechanically informed continuum model of hydrogen embrittlement," Journal of the Mechanics and Physics of Solids 52 (2004) 2403 – 243.

KEYWORDS: corrosion, metal, alloy, computational materials engineering

OSD09-C02 TITLE: Innovative Methodologies for the Development of a High Strength, Anodize-Free Corrosion Resistant, Aerospace Aluminum Alloys

TECHNOLOGY AREAS: Materials/Processes

OBJECTIVE: Develop a high strength aluminum alloy that does not require anodization to achieve corrosion resistance.

DESCRIPTION: The cost of corrosion for DoD is between $10-$20B per year. The impact of corrosion on naval aviation is huge. Over 100 million work hours and $1-3 billion/yr. is spent on corrosion related maintenance of naval aviation aircraft and ships (Cost of corrosion report had $3B for Navy/USMC aviation; $2.4B for Navy ships). Light-weight, high strength, aluminum alloys are used extensively throughout Navy aircraft and ships, unfortunately, the repair and maintenance of corrosion damaged aluminum components is a major cost driver.

Presently, virtually all aerospace aluminum alloys are anodized as a means of enhancing corrosion protection. Unfortunately, the anodization process can reduce the high cycle fatigue performance by as much as 15% resulting in designs with increased structural weight. Further, the anodization process results in a hazardous materials waste stream which is costly and potentially dangerous. Consequently, innovative alloying approaches are needed to develop anodize-free, corrosion resistant, aluminum alloys with 7075-T6 mechanical properties and with corrosion properties equal to or better than hard chrome anodized 7075-T6

PHASE I: Develop novel alloying approaches for improved corrosion resistant aluminum alloys that do not require hard chrome anodization. Demonstrate the feasibility of one such approach by producing and testing laboratory quantities of the aluminum alloy.

PHASE II: Provide practical implementation of a production-scaleable process to implement the recommended approach developed under Phase I. Evaluate the approach through the production and testing of a sufficient quantity of material property test coupons. Demonstrate feasibility by performing cost trade studies on selected aircraft components.

PHASE III DUAL-USE APPLICATIONS: Transition the approach to the production of an aircraft or ship component. Corrosion resistant aluminum alloys have wide-spread commercial application in the aerospace and marine ship building industry.

REFERENCES:
1. William E. Frazier, “Corrosion-Resistant Alloys for Naval Aviation,” Advanced Materials & Process, March 2007.

2. David A. Forman, Eric F. Herzberg, James C. Tran, Amelia R. Kelly, Paul N. Chang, Norman T. O’Meara, Ph.D., “The Annual Cost of Corrosion for Navy and Marine Corps Aviation Equipment” (LMI Government Consulting, Report MEC70T3, May 2008). Draft.

KEYWORDS: corrosion, metal, aluminum alloy, anodization, anodize

OSD09-C03 TITLE: Highly Corrosion Resistant Aluminum Alloys: Innovative Processing Methods to Enhanced Corrosion Resistance (e.g., layered structures, etc.)

TECHNOLOGY AREAS: Materials/Processes

OBJECTIVE: Develop highly corrosion resistant aluminum alloys through the application of innovative processing and fabrication techniques.

DESCRIPTION: The cost of corrosion for DoD is between $10-$20B per year. The impact of corrosion on naval aviation is huge. Over 100 million work hours and approximately $5.4 billion/yr is spent on corrosion related maintenance of naval aviation aircraft and ships. Light-weight, high strength, aluminum alloys are used extensively throughout Navy aircraft and ships, unfortunately, the repair and maintenance of corrosion damaged aluminum components is a major cost driver. Presently, the aluminum alloys used are monolithic in nature, and have a homogenous chemical composition and a uniform microstructure. Altering the chemistry and/or microstructure through the cross section of the alloy offers the potential to retard corrosion and corrosion fatigue damage; however, technology implementation may be cost prohibitive. Alloys are sought with properties comparable to 7050-T7, but having a 3x improvement in corrosion fatigue. Alloys are also sought having the mechanical properties of 7075-T6 and a stress corrosion cracking threshold stress >75% of the alloy’s yield strength.

PHASE I: Develop efficient low-cost processing and fabrication techniques for making corrosion resistance, high-strength aluminum alloys. Demonstrate the feasibility of applying one such approach by fabricating and testing coupon specimens.

PHASE II: Provide practical implementation of a production-scaleable process to implement the recommended approach developed under Phase I. Evaluate the approach through the fabrication and testing of a sufficient quantity of material property test coupons. Demonstrate feasibility by performing cost trade studies on selected aircraft components.

PHASE III DUAL-USE APPLICATIONS: Transition the approach to the production of an aircraft or ship component. Corrosion resistant aluminum alloys have wide-spread commercial application in the aerospace and marine ship building industry.

REFERENCES:
1. William E. Frazier, "Corrosion-Resistant Alloys for Naval Aviation," Advanced Materials & Process, March 2007

2. David A. Forman, Eric F. Herzberg, James C. Tran, Amelia R. Kelly, Paul N. Chang, Norman T. O'Meara, Ph.D., "The Annual Cost of Corrosion for Navy and Marine Corps Aviation Equipment" (LMI Government Consulting, Report MEC70T3, May 2008). Draft.

KEYWORDS: KEYWORDS: corrosion, metal, aluminum alloy, microstructure, thermo-mechanical processing

OSD09-C04 TITLE: Innovative Approaches for the Development of Ultra-High Strength Intrinsically Corrosion Resistant Steel

TECHNOLOGY AREAS: Materials/Processes

OBJECTIVE: Develop a new, corrosion resistant steel alloy with AerMet 100-type alloy mechanical properties with 3X improvement in KISCC.

DESCRIPTION: The cost of corrosion for DoD is between $10-$20B per year. The impact of corrosion on naval aviation is huge. Over 100 million work hours and approximately $5.4 billion/yr is spent on corrosion related maintenance of naval aviation aircraft and ships. Ultra high strength steels are used in the most demanding applications requiring a combination of high strength, toughness, and low volume, e.g., aircraft landing gear. Current state-of-the-art alloys, such as AeroMet 100, possess an excellent combination of strength and toughness. Unfortunately they are not corrosion resistant and require the use of complex and costly materials protection schemes.   An ultra high strength stainless steel with mechanical properties equivalent to AeroMet 100 and the corrosion resistance of a PH 13-8 (H1025) is desired. Representative desirable properties include:
UTS (ksi) > 290
YS (ksi) > 245
KIC (ksi   ãin) > 100
KISCC (ksi   ãin) > 70

PHASE I: Design and modeling of candidate alloys for low cost, corrosion resistant, high strength, high fracture toughness landing gear components. Demonstrate the feasibility by producing and testing laboratory scale quantities of steel.

PHASE II: Provide practical implementation of a production-scaleable process to implement the recommended approach developed under Phase I. Evaluate the approach through the production and testing of a sufficient quantity of the material   fs properties in the form of test coupons. Demonstrate feasibility by performing cost trade studies on selected aircraft components.

PHASE III DUAL-USE APPLICATIONS: Transition the approach to the production of aircraft steel components. A high strength, high fracture toughness, corrosion resistant metal alloy has the potential for transition to commercial aircraft market for cost reduction and enhanced landing gear life expectancy.

REFERENCES:

1. William E. Frazier, Corrosion-Resistant Alloys for Naval Aviation, Advanced Materials & Process, March 2007

2. David A. Forman, Eric F. Herzberg, James C. Tran, Amelia R. Kelly, Paul N. Chang, Norman T. O Meara, Ph.D., The Annual Cost of Corrosion for Navy and Marine Corps Aviation Equipment (LMI Government Consulting, Report MEC70T3, May 2008). Draft.

KEYWORDS: corrosion, metal, ultrahigh strength steel, computational materials engineering, aircraft landing gear

OSD09-C05 TITLE: Innovative Concepts for Rapid and Inexpensive Testing for Threshold Stress Intensity (KISCC) under Stress Corrosion Cracking (SCC) Conditions of Aluminum Alloys

TECHNOLOGY AREAS: Materials/Processes

OBJECTIVE: Research and develop innovative ideas that will lead to the development of a new, rapid and inexpensive method for measuring KISCC in aluminum alloys.

DESCRIPTION: Because of its high strength and light-weight, aluminum is increasingly being used in both shipboard and airborne systems. SCC of aluminum is of particular concern in the chloride containing environments that are typical for naval operation and is increasingly investigated as part of the system design process for naval aircraft structures and subsystems. Most SCC data available for design use is in the form of a threshold stress values; that is a maximum stress that the alloy of a particular orientation will withstand without developing SCC. The testing is usually performed using smooth round bar specimens under constant loading in the environment of interest (salt water for example) for a set length of time. The use of smooth bar specimens results in alphabetic ranking that are difficult to apply in crack sensitive systems where fracture mechanics criteria such as KISCC are needed. The typical test duration (ranging from a few hours to a few thousand hours) is very short compared to the design life of the system but is still very long and expensive relative to most mechanical testing protocols. While longer duration tests typically determine lower threshold values (indicating that still longer duration tests are needed), SCC tests of aluminum are fundamentally limited to duration due to general corrosion effects. Additionally, SCC testing in general does not provide a clear acceleration factor for testing. Thus, presently SCC data is expensive to generate and of limited value in design. What is needed is a rapid and inexpensive test method for determining KISCC in aluminum alloys. The test method should

1. Determine KISCC according to recognized fracture mechanics criteria;
2. Provide a basis for clearly determining the appropriate test duration;
3. Have a typical test duration of a few hours to a few days;
4. Provide a measure of the acceleration factor (such as da/dt or equivalent);
5. Be mechanically versatile (for example be capable of measuring KISCC in the HAZ of weld joint, or in the S-L orientation of aluminum plate).

PHASE I: Identify, research, explore, develop and analyze a novel concept for rapid and inexpensively measuring KISCC of aluminum alloys. Determine the feasibility of the concept by measuring KISCC for one or more aluminum alloys at different grain orientations and relate it to hardware performance.

PHASE II: Design, fabricate and demonstrate test equipment, methods and software to implement the concept. The contractor is encouraged to demonstrate the concept by measuring KISCC for several aluminum alloys at various grain orientations.

PHASE III DUAL-USE APPLICATIONS: The contractor will improve the performance of the concept and seek standardization through a nationally recognized standards organization. The test method and equipment developed through this program are expected to have potential commercial applications for testing for KISCC in aluminum alloys. The rapid and inexpensive method for the determination of KISCC for aluminum alloys can be used commercially and widely. (The method and equipment of the KISCC determination for steels, Rising Step Loading Method, has been used widely, successfully, and commercially.)

REFERENCES:
1. ASTM F 1624-05, Standard Test Method for Measurement of Hydrogen Embrittlement Threshold in Steel by the Incremental Step Loading Technique.

2. ASTM F 519-97, Standard Test Method for Mechanical Hydrogen Embrittlement Evaluation of Plating Process and Service Environments.

3. S. L. Winkler and H. M. Flower, "Stress Corrosion Cracking of Cast 7XXX Aluminum Fibre Reinforced Composites," Corrosion Science, Vol. 46, Issue 4, 2004, pp. 903-915.

4. Mohamed Ragab Bayoumi, "The Mechanics and Mechanisms of Fracture in Stress Corrosion Cracking of Aluminum Alloys," Engineering Fracture Mechanics, vol. 54, 1996, pp. 879-890.

KEYWORDS: stress corrosion cracking (SCC), KISCC (threshold stress intensity for SCC), aluminum alloys

OSD09-H01 TITLE: Cognitive/Motor Therapy Application Using Console-Based Videogame Platform

TECHNOLOGY AREAS: Biomedical, Human Systems

OBJECTIVE: To develop a highly interactive PC or web-based videogame application using a videogame console platform for improving cognitive, motor, and sensory performance following traumatic brain injury.

DESCRIPTION: Videogame Consoles provide the opportunity for developing "Serious Game" applications using standardized platforms at relatively low cost and can be used in both the clinic or at home. The videogame industry has also produced compelling entertainment applications which tout both cognitive and motor performance improvements as goals. However, as a "Serious Game" application, tasks must be empirically demonstrated as being both safe and effective. We are looking for the development of innovative applications that explore and harness the power of "advanced" interactive multimedia computer game technologies using videogame consoles to facilitate rehabilitation and improve cognitive, motor, and sensory functioning in brain injured patients. The system should incorporate the best-practices of the videogame industry, including intuitive controls, story-telling, user-feedback (for performance assessment), and high-quality graphics & sound. The current solicitation is not aiming to build entertainment, but a validated tool for cognitive/motor therapy that patients find enjoyable to use. Proposals must clearly outline how the application they are proposing will improve patient performance in cognitive, motor, and sensory tasks and why they would expect these improvements to transfer from the game environment into the "real world". Performance metrics and goals must be developed first and the application designed and developed to address those metrics. Development software must be based on mature technology with proven functionality and performance. In addition to the visual representations on the computer screen, the system should also provide user feedback including, but not limited to, an after-action report to summarize current performance and performance change over time. Activities should be guided by a virtual trainer and task performance should be available to clinicians. Proven track record for creating similar types of applications is desired, but not required. Development plans should include the use of trained psychological health and brain injury experts with experience providing services to military populations to help devise scenarios and strategy that are both safe and effective.

PHASE I: Development of a complete concept plan, concept design for the overall system and a simple working prototype. In this concept plan, address the following items with respect to the Phase II requirements:
1. Describe, illustrate, and storyboard a complete game scenario with the help of medical Subject Matter Experts.
2. With help of medical Subject Matter Experts, identify key variables and performance metrics which can be used to measure program effectiveness and patient outcomes. Use these measures to help design systems.
3. Outline technology limitations and risks, including minimum system requirements.
4. Identify development tools for producing the simulation.
5. Devise an implementation and detailed validation plan

6. Devise a basic demonstration on gaming console

PHASE II:
1. Build and demonstrate the prototype system.
2. Embed metrics for performance assessment.
3. Validate system performance and effectiveness.

PHASE III DUAL USE COMMERCIALIZATION: Issues associated with seeking psychological health and traumatic brain injury services cut across military and civilian sectors. Developing low-cost portable systems such as this could revolutionize rehabilitative services across domains.

KEYWORDS: Game-based training, traumatic brain injury, Psychological Health, Behavioral Health

OSD09-H02 TITLE: Non Invasive Assessment of Intracranial Pressure and Cerebrovascular Status after Traumatic Brain Injury

TECHNOLOGY AREAS: Biomedical

ACQUISITION PROGRAM: Office of the Principal Assistant for Acquisition, USAMRMC

OBJECTIVE: Prototype or refine and test a man portable system that can provide battlefield triage and monitoring of traumatic brain injuries (TBI). The system shall be able to provide diagnostic data related to intracranial pressure (ICP), cerebrovascular status (e.g. existence of traumatic cerebral vasospasm (TCV)), and preferably cerebral perfusion pressure (CPP), cerebral blood oxygen levels (pO2) and intracranial hemorrhage (ICH).

DESCRIPTION: Continuing developments in ultrasound technology, such as 3D and High Frequency Ultrasound, suggest it as one potential method for noninvasively monitoring ICP and cerebral blood flow (CBF), while also detecting the presence of intracranial hemorrhage ICH) and decreased cerebral perfusion pressure [1-6]. Ophthalmodynamometry and Ultrasound-obtained optic nerve sheath diameter measurements have been shown to provide accurate assessment of increased intracranial pressure [7-9]. Arterial pulse phase lag is another potential metric. Ocular Coherence Tomography of the optic nerve has also demonstrated potential promise for detecting abnormalities in the CNS and could potentially be used to assess axonal abnormalities after TBI induced swelling or increased ICP [10]. Trans Cranial Doppler (TCD) has demonstrated traumatic cerebral vasospasm (TCV) in blast TBI casualties and has also shown promise in demonstrating vascular reactivity abnormalities in mild TBI in athletes [11-14]. To make these or any competing technologies practical for combat casualty care, they must be integrated into a portable, low-power diagnostic unit. Such a system should also have a simple interface that makes the system easy to use by medics, physician assistants and general trauma surgeons in a battlefield setting. Resulting data and its interface should be easily interpreted by these end users as well.

Performance Objectives: Ability to provide rapid assessment of intracranial pressure elevation is of primary importance; device should be hand held or easily man portable, emphasis on minimal size and weight; ability to detect cerebral blood flow (and vasospasm) is also highly desired; ability to detect cerebral perfusion pressure, blood oxidation and intracranial hemorrhage are desired but not mandatory; The system would need to be validated by comparison with the gold standard of invasive intracranial pressure monitoring and computed tomography angiography (CTA) for the Traumatic Cerebral Vasospasm component; The system should be capable of producing multiple measurements over time which are consistent; Patient position should not impact measurement; Presence of closed skull fracture should not impact measurement; The device should be capable of performing measurements without repeated calibration, providing consistent measurements within and between patients; The device should be capable of being used on both conscious and unconscious patients. The device should be easily used on an unconscious or uncooperative (due to brain injury or unconsciousness) patient

Background. From previous wars, it has been estimated that approximately 20% of all military casualties have sustained a brain injury [15], and in a Defense and Veterans Brain Injury Center study of 433 injured soldiers returning from Iraq, 60% were found to have a closed brain injury [16]. Between 2003 and 2006 the annual number of clinical encounters of servicemembers with TBI was between 11,000 and 13,000 [17]. Approximately 85% of these injuries are categorized as mild, while the remainder are moderate and severe. This dramatic increase has been attributed to improved body armor—leading to a higher survival rate in blast injuries—and improved diagnosis of mild and moderate traumatic brain injury once a soldier has been evacuated. The Centers for Disease Control reports that over 1.4 million people suffer TBI annually [18]. While mild TBI is much more frequent, moderate and severe TBI can be much more devastating and therefore require optimal monitoring from the point of initial care through evacuation to the highest echelons of care. Improved diagnosis of TBI during the early posttraumatic period will significantly reduce the risk of secondary ischemic injuries and reduce mortality and morbidity of TBI. In the case of mild TBI, a diagnostic tool capable of assessing vascular dysfunction could assist in determining whether a patient must be evacuated or monitored and returned to duty.

PHASE I: Analyze the problem of field-based intracranial pressure and cerebrovascular monitoring and determine technical feasibility of a combination system capable of monitoring intracranial pressure and cerebrovascular status according to the performance objectives noted in the topic description. Develop engineering specifications and, if feasible, develop a prototype system. Deliver a report of the technical feasibility and engineering specifications to include a description of plans for performance objectives and validation for phase II execution. This includes the preparation of plans and protocols for any required animal or human testing, Food and Drug Administration (FDA) compliance issues as well as seeking local and Army regulatory approvals for potential phase II work. Any phase I animal or human subject research is highly discouraged unless existing protocols are already approved by local boards and can be quickly prepared for second-level review by the U.S. Army Medical Research and Materiel Command Office of Research Protections (USAMRMC ORP).

PHASE II: Build a prototype man-portable or handheld battlefield TBI diagnostic and monitoring system, refine any additional performance objectives met in phase I and conduct system tests on appropriate animal and phantom models. Validate the system by demonstrating equivalence to invasive monitoring. If capable, conduct human clinical trials and obtain FDA approval for use.

PHASE III DUAL USE APPLICATIONS: Transition the capability to dual use in civilian and military emergency departments/Forward Surgical Teams/Combat Support Hospitals, and with military and civilian medical first responders. For example, the device could be used by paramedics at the site of injury to allow for immediate neuroprotective care to be provided. Data could be forwarded verbally or via wireless communications from the device itself to neurosurgical experts for real time consultation in the field.

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KEYWORDS: ultrasound, ophthalmodynamometry, traumatic brain injury, intracranial pressure, cerebrovascular, transcranial Doppler, Optical Coherence Tomography, TBI, ICP, blast injury, monitor, diagnosis

OSD09-H03 TITLE: <u>Virtual Dialogue Application for Families of Deployed Service Members</u>

TECHNOLOGY AREAS: Biomedical, Human Systems

OBJECTIVE: To develop a highly interactive PC or web-based application to allow family members to verbally interact with "virtual" renditions of deployed Service Members.

DESCRIPTION: The Defense Centers of Excellence for Psychological Health and Traumatic Brain Injury recognizes that family outreach and advocacy is pivotal for both the psychological health of the family and the resilience of the Service Member. Deployments put stress on the entire family, especially small children and communication is key. The ability to reach out and communicate with loved ones from areas of conflict is better than at any time in history. Nevertheless, the stresses of deployment might be softened if spouses and especially children could conduct simple conversations with their loved ones in immediate times of stress or prolonged absence. Historically, families have derived comfort and support from photographs or mementos, but current technology SHOULD allow for more personal interactive messages of support. Over 80% of American children between the ages of three and five regularly use computers, and 83% of families have a computer in their home. So, computer-based applications would resonate with children and capture their interest and imagination. The challenge is to design an application that would allow a child to receive comfort from being able to have simple, virtual conversations with a parent who is not available "in-person". We are looking for innovative applications that explore and harness the power of “advanced” interactive multimedia computer technologies to produce compelling interactive dialogue between a Service member and their families via a pc- or web-based application using video footage or high-resolution 3-D rendering. The child should be able to have a simulated conversation with a parent about generic, everyday topics. For instance, a child may get a response from saying "I love you", or "I miss you", or "Good night mommy/daddy." This is a technologically challenging application because it relies on the ability to have convincing voice-recognition, artificial intelligence, and the ability to easily and inexpensively develop a customized application tailored to a specific parent. We are seeking development of a tool which can be used to help families (especially, children) cope with deployments by providing a means to have simple verbal interactions with loved ones for re-assurance, support, affection, and generic discussion when phone and internet conversations are not possible. The application should incorporate an AI that allows for flexibility in language comprehension to give the illusion of a natural (but simple) interaction. The current solicitation is not aiming to build entertainment, but a highly accurate and advanced simulation platform. Voice-recognition and voice-interaction are required. The User Interface is a critical component for this program. Application must be user friendly and application must be easy to install and maintain. Verbal interactions should be as normal as current technology will allow. Proven track record for creating similar types of applications is desired, but not required. Development plans should include the use of trained psychological health and family advocacy experts with experience providing services to military populations. Project MUST include discussion of how personal information would be collected, recorded, and rendered as well as address issues about information content and complexity of proposed simulation application. If using a web-based application, security and maintenance issues must be addressed. Application must run on typical family-owned computer systems.

PHASE I: Work with DoD Subject Matter Experts to define exact needs and scope of the application. Provide for the development of a complete concept plan, concept design for the overall system and a simple working proof-of-concept demonstration. In this concept plan, address the following items with respect to the Phase II requirements:
1. Develop metrics to determine user acceptance, usability, and content requirements.
2. Describe, illustrate, and storyboard a complete scenario with the help of Subject Matter Experts.
3. Outline technology limitations and risks, including minimum system requirements.
4. Identify development tools for producing the simulation.
5. Devise an implementation and plan for a detailed usability study
6. Develop a basic proof-of-concept demonstration of technology

PHASE II:
1. Finalize application design based on Phase I results
2. Build, refine, and demonstrate the prototype system.
3. Perform user acceptance and usability study
4. Develop strategy for customizing simulation for military families.

Phase III DUAL USE COMMERCIALIZATION: This technology would be useful for providing support for civilian families and could be easily expanded to provide highly-interactive training and “lessons-learned” from experts in the field.

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KEYWORDS: Interactive Simulation, Family Advocacy, Psychological Health, Behavioral Health, Dialogue, Family Support

OSD09-H04 TITLE: Development of Virtual Reality Tools for Assessment of Return-to-Duty Status following Mild Traumatic Brain Injury (mTBI)

TECHNOLOGY AREAS: Biomedical

ACQUISITION PROGRAM: Office of the Principal Assistant for Acquisition, USAMRMC

OBJECTIVE: Design, prototype and provide preliminary validation data for a virtual reality based assessment tool for use in determining return-to-duty status in patients diagnosed with mild traumatic brain injury (mTBI). The system must allow the quantitative assessment of individual performance during rigorous, simultaneous physical and cognitive demands within a game-based virtual reality environment.

DESCRIPTION: Exposure to blast trauma during combat activities in theatre has resulted in an alarming number of mTBI diagnoses in military service members. There is a growing body of evidence to suggest that static, dynamic, and high-level balance activities are affected following concussive injury (Parker, Osternig et al. 2007). Mission readiness often requires an individual be prepared to perform rapid simultaneous physical and cognitive tasks. Existing clinical assessment techniques typically fail to assess the ability to execute functional tasks incorporating whole-body movements. Thus, a critical gap exists in the ability of clinicians to assess a servicemember’s ability to return to duty. Vestibular testing, static balance, and dynamic gait assessments have been used to detect and quantify postural instability and cognitive impairments not detected in clinical examinations, but reported by TBI patients. It follows that assessment techniques incorporating real-world functional activities combining physical activity and cognitive demand may aid in the identification of individuals not yet ready to return to the full spectrum of military duties.

Virtual Reality (VR) technologies have been used in many areas of medicine, to include helping patients to overcome phobias, manage pain, and reduce anxiety (Rothbaum, Hodges et al. 2001; Hoffman, Sharar et al. 2004; Rizzo, Graap et al. 2008). Virtual reality environments also provide the ability to expose wounded service members to ecologically valid and challenging scenarios in a controlled and repeatable manner ideal for patient assessment.

The aim of this topic is to facilitate the development of a virtual reality game-based patient assessment system which has high potential for rapid implementation in military treatment facilities. Therefore, the successful applicant must have demonstrated experience with medical assessment or rehabilitative applications. The proposed system must be low cost or have the potential for implementation using low cost modification of existing equipment already in use in military treatment facilities. The proposed investigators must a) have existing capacity to design and produce an independent system or b) have documented support from a manufacturer of existing equipment that can be modified for the desired purpose. The proposed assessment techniques must be grounded in scientific evidence and must either include or build upon established forms of cognitive and physical assessment. Successful applicants must have demonstrated ability, or potential to successfully work with subject matter experts to develop the testing paradigm.

This system should be designed to provide clearly defined and easily interpreted measures of physical and cognitive performance for use by treating clinicians. It is anticipated that by providing a means of quantifying performance during combined cognitive and physical tasks the assessment tool will prove useful for assessing the effectiveness of rehabilitative strategies and assisting with return to duty determination.

Required features include functionally relevant whole body movement, cognitively demanding tasks, a clear means of quantifying performance, weapons carriage and targeting, and visualization that resembles that encountered by service members in theatre. To facilitate implementation the associated software must have a user-friendly interface that can be easily learned by existing staff within military treatment facilities. The system must provide the ability for on-site development or modification should the needs of the clinical team change.

Desirable features include environment assessment and object identification within a high fidelity virtual environment.

PHASE I: Development of a detailed and comprehensive plan for a system that will allow the identification of performance impairments using simultaneous physical and cognitive tasks.
1) With consultation of military and civilian subject matter experts identify physical and cognitive performance metrics that are military relevant and can be implemented during whole body movement. Metrics must allow the identification of impairments in the absence pre-injury data.
2) Clearly outline the sequencing, format and presentation of cognitive and physically demanding tasks within the virtual environment.
3) Clearly identify the existing hardware and software components that are required to produce the assessment product including a detailed budget of total equipment costs.

PHASE II: Implement the plan proposed in Phase I to include the fabrication, testing and initial data collection
1) Build and demonstrate the prototype system
2) Collect preliminary data on uninjured individuals
3) Collect preliminary data on patients with mTBI under the direct supervision of treating clinicians. Perform initial validation of system based on previously determined metrics.

PHASE III DUAL USE APPLICATIONS:
1) Translate product to clinical use, to include clinical testing and FDA requirements, as appropriate.
2) Commercialization of the resulting application, marketing to both military and civilian customers.
3) Present to appropriate Army and DoD acquisition authorities for consideration of initiation of technology insertion into the Military Healthcare System.

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KEYWORDS: Virtual reality, rehabilitation, mTBI, game-based technologies

OSD09-H05 TITLE: <u>Utilization of Affective Computing for Cognitive and Physical Rehabilitation of Victims of Traumatic Brain Injury</u>

TECHNOLOGY AREAS: Biomedical

ACQUISITION PROGRAM: Office of the Principal Assistant for Acquisition, USAMRMC

OBJECTIVE: Develop and demonstrate an affective computing interface that can be used for cognitive and physical rehabilitation of victims of traumatic brain injury. This interface will be developed to interoperate with new and existing cognitive and physical rehabilitation tools. It will provide patients with improved functional outcomes across cognitive and physical domains.

DESCRIPTION: Traumatic brain injury (TBI) has been called the "signature injury" of the Global War on Terrorism. New body armor and armoring of vehicles, as well as improved pre hospital and surgical care has resulted in increased survivability. However, survivors of the extremely violent improvised explosive device (IED) are faced with multiple injuries including extremity and brain injury. Between 2003 and 2006 the annual number of clinical encounters of servicemembers with TBI was between 11,000 and 13,000. Approximately 85% of these injuries are categorized as mild, while the remainder are moderate and severe. The Centers for Disease Control reports that over 1.4 million people suffer TBI annually. The Army has been assessing its management of TBI and is currently identifying the best therapies and most promising technologies for advancing treatment of TBI. This topic is an effort to leverage emerging technologies for the improved treatment of this injury. TBI is often associated with cognitive sequelae to include: short and long term memory impairments, emotional lability, communication disorders (speech, hearing), attention, and goal orientation impairments (executive function). Physical sequelae include: weakness, balance disorders, coordination disorders, neglect of parts of the body, sensory disorders (touch), and vision disorders (field cuts/blindness, eye movement). Recent advances in neuroscience and neuroinformatics have begun to demonstrate the interrelationships of motor and cognitive functions and their circuitry. This knowledge lends more credence to the development of advanced cognitive and physical rehabilitation systems.

Affective computing utilizes combinations of artificial intelligence and physiological monitoring of human emotional states to drive computer-human interfaces. Physiologic measures include skin conductivity, heart rate, respiratory rate and facial expressions, the latter being accomplished by applications such as FACES. These technologies have been utilized for applications related to physical fitness, rehabilitation, medical informatics, and neuroprosthetics. Affective computing systems appear well suited for integration with game-based applications as well as virtual reality systems of any complexity.

The goals of the topic are:

1. Refine/develop an affective computing interface for utilization with existing or novel cognitive and/or physical rehabilitation tools. As noted, game-based as well as immersion virtual reality systems would be appropriate formats. This system should be focused on the rehabilitation of patients with mild to severe TBI.

2. It is desirable for the system to utilize an avatar representing the user and/or a virtual therapist.

3. The system must be developed in an open framework with the goal of interoperability with existing hardware/software. An example of a hardware/software interface for cognitive/physical rehabilitation used by the Army is the MOTEK CAREN system. Another example would be console-based gaming and training systems, some of which might be in development simultaneously with this effort. Software interoperability for advanced distributed learning related to training and rehabilitation can be accomplished through the use of the Sharable Content Object Reference Model (SCORM). SCORM conformance is a requirement for advanced distributed learning tools in the Department of Defense.

4. The system must be developed in a manner such that its components can be re-utilized for other types of treatment and rehabilitation. (e.g. psychiatric (PTSD), trauma (amputee care))

PHASE I: The awardee will work with Department of Defense Subject Matter Experts to define the needs and scope for the application. Deliverables of the Phase I effort will include a feasibility analysis including use-case scenarios, a design concept of the application, initial refinement and demonstration of any existing components of the application. The awardee will select two or more existing or new cognitive/physical rehabilitation applications (at least one will be a game-based modality) in which the affective computing component will be demonstrated in Phase II. Performance metrics for Phase II testing and validation will be defined based upon results of feedback from SMEs and the feasibility analysis. Any FDA approval requirements will be defined and plans for obtaining FDA approval will be included as part of the Phase II work plan.

PHASE II: In phase II the awardee will continue development and refinement of the application, resulting in a functional prototype. The prototype will be tested and validated with healthy subjects and TBI patients of mild to severe impairment. If possible, the system will be tested and validated in a military treatment facility. FDA exemptions and/or approvals will be sought. Results of the testing and validation studies will be used to further refine the application into its final form for clinical translation.

PHASE III DUAL USE APPLICATIONS: The Phase II awardee will complete any remaining refinement and translation to clinical use objectives to include additional clinical testing and FDA requirements. Commercialization of the resulting application will occur. Successful clinical application will result in a therapy system for use in the cognitive and physical rehabilitation of military and civilian TBI patients. The successful application will be presented to the appropriate Army and DoD acquisition authorities for consideration of initiation of technology insertion into the Military Healthcare System. Additional funding may be provided by DoD sources but the awardee must also look towards civilian funding sources to continue the process of translation and commercialization.

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19. Clarification from TPOC for Topic OSD09-H05:
In the Phase I requirements it is noted that "The awardee will work with Department of Defense Subject Matter Experts to define the needs and scope for the application."
While we do have access to DOD experts, the teams are welcome to engage DOD and or VA experts on their own and or utilize civilian experts who have worked with veterans and or understand their unique needs. DOD experts assisting with the government management team will need to be able to assist any/all teams awarded phase I funding, so their time will be limited.
Therefore, it is quite acceptable to develop contacts with your own subject matter experts who would be able to be committed to your project alone.

KEYWORDS: Traumatic Brain Injury, Affective Computing, Rehabilitation, Therapy, Cognitive therapy, Training, Artificial Intelligence, Physiological monitoring, Trauma, Emotion, Memory, Learning, Brain machine interface