National Imagery and Mapping Agency University Research Initiatives - NURI

CONTENTS

I. Introduction II. General Information III. Areas of Interest IV. Conditions V. Requirements for White Papers and Proposals VI. Evaluation Criteria and Selection Process VII. Awards VIII. Specific Research Topics for FY00 NURI IX. Significant Dates

Appendix A: FAR Late Submission Clause

The National Imagery and Mapping Agency UNIVERSITY RESEARCH INITIATIVES

I. INTRODUCTION

The National Imagery and Mapping Agency (NIMA) announces a Fiscal Year 2000 competition for the NIMA University Research Initiative (NURI). NURI is a NIMA initiative to enhance universities' capabilities to perform research and related education in science and engineering areas critical to NIMA missions and national defense.

NURI supports research teams whose efforts intersect more than one traditional science and engineering discipline. Multidisciplinary team effort can accelerate research progress in areas particularly suited to this approach and also can help to hasten the transition of research findings to practical application. By supporting team efforts, NURI complements other DoD programs that support university research principally through single-investigator awards.

The U.S. National Science Foundation shares many of the fundamental research goals detailed in this announcement, which have scientific merit beyond the specific objectives of the Department

of Defense. Relevant NSF Program Officers expect to participate in the review, selection, and support of some projects submitted in response to NURI.

II. GENERAL INFORMATION

Through this NURI competition, the National Imagery and Mapping Agency expects to make awards in several specific research topics, subject to the availability of funds. All awards will be based on merit competition. The agency expects that typically each award will be:

- for a basic period of three years (funded incrementally or as options), with two optional additional years, and
- on average about \$130 thousand per year.

Given these award sizes, NURI provides more funding for critical research infrastructure elements than traditional, single-investigator awards. Therefore, to support the proposed research, a NURI proposal may request proportionately more funding than a single-investigator proposal for training graduate students and for acquiring or refurbishing equipment needed to conduct the proposed research.

III. AREAS OF INTEREST--GENERAL

Six research areas, comprising a number of enabling technologies, and a seventh area of interest, are described in Section VIII. These descriptions are intended to provide proposers with a frame of reference for NIMA research interests. Innovative ideas that address these interests are encouraged. Proposers are urged to consider carefully the research issues posed, and, as appropriate, to contact the research topic chiefs to discuss potential efforts of mutual concern. Inquiries are welcome. Note, however, that while technical contacts are listed for a topic, proposals must be directed only to the addressees shown in Section V.

IV. CONDITIONS-- GENERAL

This NURI competition is specifically for the research topics described in Section VIII. Potential proposers are advised to read this announcement carefully. It explains the agencies' research needs upon which the topics are based and the terms and conditions of this NURI competition.

Proposals from consortia of universities may be warranted, because research in the multidisciplinary topics may require forming teams with strengths in multiple science and engineering fields. Consortia proposals must name one principal investigator as the responsible technical point-of-contact. Similarly, one institution will be the primary awardee for purposes of award execution. The relationship among the institutions and their respective roles, as well as the apportionment (i.e., sub-award) of funds among institutions, must be described in both the proposal text and budget.

Proposals from Historically Black Colleges and Universities, Hispanic-serving Institutions, Tribal Colleges and Universities, and other Minority Institutions, either individually or as members of proposing consortia, are welcomed. However, this announcement does not provide a set aside for funding proposals from these institutions. NIMA expects that NURI programs will promote application of defense research, primarily for defense purposes but also for commercial purposes. Therefore, a factor for evaluating proposals in this competition is the quality of the proposer's planned interactions with research and development organizations that transition research findings to applications -- particularly industrial organizations, DoD laboratories, and other organizations that perform research and development for defense applications. Examples of interactions that can be proposed are collaboration in the performance of the proposed research, exchange of scientific and engineering personnel, and exchanges of technical information.

To facilitate such interactions, sub-awards of NURI funds to industrial organizations are permitted. However, consistent with the principal goals of a university-based research initiative, it is anticipated that award funds will remain vested substantially with the university. Cost sharing by industrial participants is encouraged as a preferred means to achieve university-industry interactions.

When a modest amount of additional funding for a DoD laboratory/organization or a Federally Funded Research and Development Center is necessary to make the proposed interactions possible, such funds may be requested via a separate proposal from that organization. This supplemental proposal should be attached to the primary NURI proposal; it is not subject to or part of the 35-page limit of the primary proposal; and if approved it would be funded by additional agency (non-NURI) funds beyond the NURI funds available for this competition.

Each proposed interaction will be evaluated in the context of the entire proposal. The evaluation will be based on the likelihood that the proposed interaction(s) will positively impact research outcomes and transition to application.

V. REQUIREMENTS FOR WHITE PAPERS AND PROPOSALS

The proposal submission process is in two stages. First, white papers are sought from prospective proposers. Based on the evaluation of those white papers, selected proposers will be invited to submit more detailed proposals. The intent of a request for white papers is to minimize the labor and costs associated with producing a detailed proposal. All interested proposers, therefore, are **encouraged** to submit white papers. However, all proposals submitted under the terms and conditions cited herein will be reviewed, regardless of the disposition (or lack) of white papers.

1. White papers

White papers should be no longer than five typed pages and should outline: (a) Title, with enumeration of NIMA research area of interest; (b) proposed objectives and approach; (c) expected outcomes; (d) credentials of key project members; (e) costs, in summary and broken down by year.

White papers must be received by the time and date shown in Section IX.

White papers shall be submitted electronically and simultaneously to <u>FrazierE@nima.mil</u> and <u>BergR@nima.mil</u>. All files sent by the closing time will receive an acknowledgement reply via return e-mail. White papers shall be readable in Microsoft Word 97 and shall reference BAA

Number NMA202-99-BAA-02. White papers will be evaluated against criteria (1), (2), (3), and (8) of Section VI.

A notification to encourage or discourage submission of proposals will be sent directly to the Principal Investigator according to the schedule in Section IX. NIMA responses may be transmitted via e-mail or facsimile to expedite communications, so white paper respondents must include fax numbers and e-mail addresses with the submitted white papers.

2. Proposals

A. General

Because NIMA intends to award all available FY00 money with the first call, interested parties are strongly encouraged to submit completed proposals by the time and date provided in Section IX. However, proposals will continue to be accepted until 15 August 2000, and awards may be made at any time based on formal evaluation of the proposal and availability of additional money to fund it.

Please note that only the e-mail addresses provided below serve as the collection point for proposals. Proposals received after 15 August 2000 will be treated according to Federal Acquisition Regulation part 52.215-10, Sections (a)(1) through (a)(5) (see Appendix A).

Acknowledgment of receipt of a NURI proposal, and letters announcing whether or not a proposal is being recommended for an award will be e-mailed according to the schedule in Section IX directly to the principal investigator, with a copy to the appropriate university administrative office.

Proposals will be evaluated against criteria (1) through (8) in Section VI.

Awards are planned to be in place according to the grant start date identified in Section IX; this date should be cited as the proposed start date for budget purposes.

B. Submission

Technical proposals shall be readable in Microsoft Word 97 and cost proposals shall be readable in Microsoft Excel 97 with no cell references that are external to the file. Both technical and cost proposals shall reference BAA Number NMA202-99-BAA-02.

Proposals shall be submitted electronically and simultaneously to <u>FrazierE@nima.mil</u> and to <u>BergR@nima.mil</u>. Files too large for e-mail may be FTP'd to <u>ftp://164.214.2.59/pub/contracts/pce</u>. E-mail notification must be sent to the e-mail addressees above if files are sent via FTP. All files sent by the closing time will receive an acknowledgement reply via return e-mail or facsimile.

Each proposal shall be no longer than 35 pages, all-inclusive (including, for example, vitae, bibliography, cover page, budget, ...). The technical portion (see Section C.3) shall be limited to no more than 15 of the 35 pages. Separate attachments, such as institutional brochures or reprints that are not germane to the proposal, are discouraged.

C. Content

The proposal must be complete and self-contained to qualify for review.

The National Imagery and Mapping Agency is concerned with research in critical areas of science and engineering, with science and engineering education, and with the availability of equipment required to meet its research objectives. For this reason, proposals must adequately describe the technical objectives and approaches, support of students, and expenditures for equipment, all of which will be evaluated by scientific reviewers per Section VI.

Proposals should include:

(1). Cover page: To be eligible for review, proposals must indicate the name, phone number, fax number, postal address, and e-mail address of both the principal investigator AND an appropriate official in the university's administration. Include the proposal title and indicate the NIMA research area of interest. One page.

(2). Abstract: Provide a project summary no longer than one page.

(3). Project Description: The technical portion of the proposal shall be limited to 15 pages and should:

a. Describe in detail the research to be undertaken. State the objectives and approach and the relationship to state-of-knowledge in the field and to similar work in progress. Include appropriate literature citations and prior work. Discuss the nature of expected results.

b. Describe the facilities available for accomplishment of research objectives. Describe the equipment planned for acquisition under this program and its application to objectives. (When possible, equipment should be purchased very early in the research award period.)

c. Describe plans for the research training of students in science and/or engineering.

d. Describe in detail proposed sub-awards or relevant collaborations (planned or in place) with industry, government organizations, or other appropriate institutions. Particularly describe how collaborations are expected to facilitate the transition of research results to application. If sub-awards are proposed, make clear the division of research activities and provide detailed budgets for the proposed sub-awards. Descriptions of industrial collaborations should explain how the proposed research will impact the industrial partner's research and/or product development activities.

e. Identify other parties to whom the proposal has been/will be sent.

(4). Personnel: Describe the qualifications of the principal investigator and other key researchers involved in the project. Include curriculum vitae. For consortia or collaborations, one individual should be the designated principal investigator for purposes of technical responsibility and contact.

(5). Budget: The financial portion of the proposal, beginning on a new page, should contain cost estimates sufficiently detailed for meaningful evaluation, including cost details for proposed subawards. For budget purposes, use an award start date per Section IX. The budget must include the total cost of the project, as well as a breakdown of the amount(s) by source(s) of funding (e.g., funds requested from NIMA, non-federal funds and/or institutional funds to be provided as cost sharing). The costs should be broken down for each year of the program and shown by two distinct totals: a total for the basic three years and a total for each of two optional follow-on years. Costs of entertainment, amusement, diversion and social activities and any costs directly associated with such activities are unallowable. Elements should include:

a. Time being charged to the project: for whom (principal investigator, graduate students, etc.), and the commensurate salaries and benefits. Allowable charges for graduate students include salary, appropriate research costs, and tuition. Allowable charges for undergraduate students include salary and research training costs, but not tuition.

b. Fringe benefits.

c. Costs of equipment: based on most recent quotations and broken down in sufficient detail for evaluation (equipment costs should be budgeted primarily during the first year). Allowable equipment will ordinarily be limited to research equipment and apparatus not already available for the conduct of the work. General purpose equipment, such as a personal computer, is not eligible for support unless primarily or exclusively used in the actual conduct of scientific research.

d. Travel costs and time, and the relevance to stated objectives.

e. Other direct costs: materials and supplies; publication, documentation and dissemination; consultant services; computer services; communication costs not included in overhead; other (identify).

f. Sub-award costs and type (the portion of work to be sub-awarded and rationale); note that the sub-award of funds among all university and industry performers responding as one consortium must be described carefully in both the text and the cost section. Also, while collaborations with industry are very strongly encouraged, award funds are expected to be vested substantially with the academic institution(s).

g. Indirect costs.

(6). Certifications: Certifications will be executed during the negotiation of winning proposals.

VI. EVALUATION CRITERIA AND SELECTION PROCESS

Criteria

Criteria (1), (2), (3) and (8) will be used to evaluate white papers. All eight criteria will be used to evaluate final proposals.

The primary evaluation criteria, of equal weight, are:

(1) Scientific and technical merits of the proposed research; and

(2) Relevance and potential contributions of the research to defense missions;

Other evaluation criteria, of lesser importance than (1) and (2) but equal to each other, are:

(3) The qualifications of the principal investigator and other key research personnel;

(4) The adequacy of current or planned facilities and equipment to accomplish the research objectives;

(5) The potential for strengthening the institution's infrastructure, for example, by acquiring or refurbishing equipment key to meeting NIMA research objectives;

(6) The impact of plans to train students in science and/or engineering;

(7) The impact of interactions with other organizations engaged in related research and development, in particular industrial organizations, DoD laboratories and other organizations that perform research and development for defense applications; and

(8) The realism and reasonableness of cost, including proposed cost sharing.

Process

Proposals will undergo a multi-stage review. First, technical evaluation teams will review proposals using the criteria in this Section and as explained in Section V. Then the findings of the evaluation teams will be reviewed by senior agency managers.

VII. AWARDS

Awards will be made at funding levels commensurate with the research and in response to agency missions, but on average about \$130 thousand per year. Further, awards generally will be made for three years (through increments or options) with options for two additional years. Negotiations may result in funding levels more or less than originally proposed.

Letters announcing whether or not a proposal is being recommended for an award will be mailed directly to Principal Investigators according to Section IX. Awards are expected to be in place sometime after that.

VIII. SPECIFIC RESEARCH TOPICS FOR FY00 NURI

The following topics represent NIMA research interests particularly suited for NURI investment. An award in any topical area will be made only if a sufficiently meritorious proposal is received. NIMA reserves the right to allocate available funds among topics based on the quality of the responses and NIMA priorities. None, one, or more than one award may be made for an individual enabling technology. Topic titles are listed below, followed by more detailed descriptions of each.

NURI RESEARCH TOPICS:

GEOSPATIAL INFORMATION SCIENCES -- Includes uncertainty, spatio-temporal analysis, topological reasoning, information management for massive databases, integrated source management, interoperability, scale and high-dimensional representations.

PHYSICAL SCIENCES -- Includes geodesy and geophysics, hydrography, and remote sensing phenomenology including synthetic aperture radar, multispectral and hyperspectral imaging.

<u>COMPUTER SCIENCES</u> -- Includes human cognition and human-centered computing, virtual experts and intelligent agents.

NEUROSCIENCE -- Focused on neuroscience-inspired approaches (excluding classical neural network applications) to target recognition and cartographic feature extraction, either automated or to assist analysts.

IMAGE SCIENCES -- Includes imagery compression and decompression; and includes image processing capabilities of data from electro-optical, spectral and/or synthetic aperture radar sensors.

MATHEMATICS -- Includes combinatorial strategies, fractal representations and wavelets, and refinement schemes applicable to geospatial data and information.

TECHNOLOGY TRANSFER -- Focused on alternatives to the current, poorly-functioning process for tech transfer within NIMA.

NIMA Research Area: GEOSPATIAL INFORMATION SCIENCES

Background:

Geospatial Information Science encompasses the core fundamental issues surrounding the effective capture, interpretation, storage, analysis, and communication of geospatial information. The accomplishment of NIMA's mission fundamentally depends on its ability to effectively address all aspects of geospatial information -- from creation to its use in decision making.

With the recent proliferation and rapid advancement of Geographic Information Systems (GIS) and imaging technologies, the potential for geospatial information use across a variety of military, intelligence, and national decision maker applications has grown dramatically. Accompanying these applications is a diverse and growing number of users that present both opportunities and challenges ranging from time critical availability of geospatial information to its exploitation by novices in high stress environments. The unique characteristics of geospatial information that include its complexity, volume, multidisciplinary character and inherent approximation of reality combine for a rich set of research and technology issues that challenge it's potential and effectiveness for NIMA and it's customers.

Objectives:

As demands and the number and volume of potential geospatial data sources increase, vexing

problems exist for NIMA in providing timely, effective geospatial information to its customers. To meet these demands and deal effectively with the multitude of potential sources, NIMA must explore new and innovative approaches to all aspects of geospatial information development and use.

Research Concentration Areas:

Area 1: Non-traditional sources of geospatial data

Existing structured geospatial databases and overhead imagery represent the bulk of traditional geospatial data sources. These sources will remain important for the foreseeable future, but the potential to exploit other sources, along with the demand to model/depict geospatial phenomena in a more timely, accurate and multidimensional (space, time and spectral) manner necessitates the need to consider the use of other sources.

Research is needed in identifying and exploiting non-traditional sources of geospatial data from imaging and non-imaging mobile and in-situ sensors, spatial and non-spatial databases and other means to span the information content gap that will continue to exist even as traditional sources grow in number and provide increasingly large volumes of data.

Area 2: Data Representation

Current community standards for geospatial data structures are inadequate to meet the needs of multidimensional (space, time and spectral) representations that are highly descriptive, computationally efficient and support distributed production/development/maintenance and validation as well as complex modeling and analysis. Research is needed to look at fundamentally new ways to represent geospatial data (and metadata) occurring on, above, and below the earth's surface to support these needs and to form the integrating foundation for the national security community information infrastructure.

Area 3: Cognitive Models

Gaining insight into and effectively modeling the manner in which geospatial data and phenomena are perceived by the population of potential users of geospatial information is integral to understanding what data should be used and how it should be presented to users (including interaction and analysis) to insure its most effective and appropriate use. Additional research continues to be needed in this area to derive a fundamental understanding of how perception, expertise and use interrelate to drive out fundamental principles for geospatial data representation, presentation and interaction.

Area 4: Knowledge Development

The integral link between geospatial data and decision making is the development and exploitation of geospatial knowledge. Research is needed in the area of geospatial knowledge construction and management to insure comprehensive and consistent methodologies are developed to enable integrating/fusing/conflating geospatial data as well as analysis and reasoning in complex, multidimensional (spatial, temporal and spectral) discrete and continuous data spaces. Research is also needed to examine innovative means for simulating and presenting potential decision outcomes based on geospatial information and preserving knowledge created to build and maintain a corporate geospatial memory.

Impact:

Results of this research will dramatically enhance NIMA's ability to make the most relevant and effective geospatial information and knowledge available to support the widest possible range of users and applications in a timely manner. The research will also provide means for geospatial knowledge capture and maintenance as a reusable corporate enterprise resource.

Research Topic Chief: Dr. H. Gregory Smith (NIMA/TEC), (301) 227-7471, SmithHG@nima.mil

NIMA Research Area: PHYSICAL SCIENCES

Background:

A number of disciplines in the physical sciences are essential to supporting the mission of the National Imagery and Mapping Agency (NIMA). Consequently, NIMA plans to invest advance research and development funds in appropriate research concentration areas to further the advancement of these physical science disciplines. NIMA needs to continue to understand the impacts of current and emerging collection systems which supply or potentially could supply data for exploitation by imagery analysts, cartographers, hydrographers, surveyors and geodesists. The collection systems may be operated by national, tactical, civil and commercial organizations. The sensors may span the full electromagnetic spectrum – visible, infrared, and radar wavelengths. The sensors may support navigational activities (e.g., Global Positioning System (GPS) receivers), gravity data collection (e.g., gravity gravimeters and gradiometers), and bathymetric data collection (e.g., acoustic sensors).

Objectives:

The research proposal will relate to furthering the advancement of specific physical science disciplines in areas that directly support the mission of NIMA. The proposal will provide understanding of the sensor phenomenologies, and data processing techniques to facilitate the acceptance and exploitation of the provided data.

Research Concentration Areas:

Area 1: Geodesy and Geophysics

NIMA has the need to improve our knowledge of the Earth's gravity field and to improve the accuracy of the reference system (World Geodetic System 1984) that describes the position of features on the Earth's surface. Can better sensors be developed to collect gravity data either in situ or remotely? Can improvements be made to WGS 84 to more accurately position objects? Can methods be developed to express more quickly and more accurately the Earth's gravity field? Can improvements be made to GPS survey receivers or processing techniques to achieve more accurate positioning of objects? Can improvements be made in the modeling and computation of GPS ephemerides?

Area 2: Hydrography

The movement away from the standard nautical chart to the emerging electronic chart (Digital Nautical Chart - DNC) has placed demands on the quality and accuracy of the information in the databases that support the digital renditions. Specifically research is required in the areas of feature generalization, shoreline modeling and the 3D representation of marine features. Research into feature generalization to support electronic chart displays at varying scales that minimizes clutter yet conveys the necessary information is needed. In the area of shoreline modeling, research is needed to develop how best to develop a tide-coordinated digital model for a time-variant shoreline and generalizations of the shoreline without impact on the baseline points that serve as the basis for offshore limits. Also research is needed into methods that portray the most accurate 3D representation of information such as acoustic imagery when combined with the various bathymetry data sets.

Area 3: SAR/MSI/HSI Phenomenology

NIMA needs to understand how to make better use of radar and spectral data in the generation of intelligence and geospatial information. What are the optimal imagery compression techniques for radar and spectral data, especially concentrating on accuracy and speed? How can SAR phase history data be used efficiently to extract feature data, detect changes, vertical obstructions or moving targets? How can spectral data phenomenology be understood better so that it can be used efficiently to extract feature data, identify material changes, whether the material is solid, liquid or gaseous?

Impact:

This research will provide better understanding and potential technology applications to improve NIMA's productivity in providing imagery, imagery intelligence and geospatial information.

Research Topic Chief: Dr. William Stein (NIMA/TEP), (301) 227-7450, SteinB@nima.mil

NIMA Research Area: COMPUTER SCIENCE

Background:

A fundamental element of NIMA's operational vision is the creation of an information framework that will enable and support a variety of missions, policy analysis and decision making within the National Intelligence Community. The make-up of this framework will include a wide range of phenomena, articulated through different scales by a variety of information types, from digital imagery and terrain information to features and events, that are spatially and temporally dynamic, and represented through a variety of structures and formats. NIMA, as both a producer and consumer of information, requires advanced technology to facilitate the analyst's use of this information to achieve NIMA's goal of providing the 'Information Edge'.

NIMA is addressing this information handling challenge by proposing to fund research in Human Cognition/Human Centered Computing, Topological Reasoning, Knowledge Management/Virtual Experts, Intelligent Agents and Database Design and Reasoning

Methodologies.

Research Concentration Areas:

Area 1: Human Cognition/Human-Centered Computing

Background:

Human Centered Computing (HCC) is an emerging science that focuses on the melding of computer and human capabilities together into a system that synergistically exploits the capabilities and performance of each toward a specific goal or objective. HCC is characterized by viewing the two processors (human and computer) from a systems perspective. The approach requires a deep understanding of the cognitive, computational and social elements of the task at hand. The approach also exploits an understanding of human biology and psychology.

Recent decades have seen great advances in sensor and information processing technologies. Most of the advances have been in producing and moving more data and information to the decision maker. However experience has shown that these advancements have resulted in more multi-source data than the decision-maker can interpret and use effectively. Consequently, it is common for important data sets to be ignored while potentially less important, but more stridently presented data sets are used. The result is a less informed decision. The current and projected imbalance between the amount of imagery collected and the ability for analysts to effectively exploit all of this imagery makes HCC relevant to the future success of the Agency.

HCC offers a view in which the interplay between human thought and action and technology systems are understood as inextricably linked and equally important aspects of analysis, design and evaluation. Decision support systems for the analyst as well as the NIMA customer can have a direct effect on the types, quantity and accuracy of data and information that NIMA must develop and deliver to its customers.

Objectives:

The objectives of this program are: (1) identify, develop, and assess human and machine cognition technologies as applied to more efficient imagery exploitation and geospatial production, (2) to further the research in areas relevant to applications within NIMA and the IGC, (3) to assess whether NIMA and IGC adoption of human and machine cognition technologies will overwhelm the analytic workforce, and (4) prototype and demonstrate the technologies as applied to NIMA and military exploitation systems.

Impact:

NIMA is faced with an ever increasing disparity between the amount of information to be exploited and the number of analysts to do the exploitation. This technology could provide the augmentation that the NIMA workforce will require in the future to deal with the imbalance. The systematic use of the computer and human resource has the potential to change the way in which sources are exploited and consequently the quality of the exploitation process.

Area 2: Knowledge Management/Virtual Experts

Background:

Information sources for imagery analysts are becoming more diverse and more technically

capable. During the last decade, the art of imagery analysis has migrated from counting and reporting only observations to performing analysis and assessments. Because of the advanced capabilities of our sensors today, policy makers and battlefield commanders are asking much more complex and detailed questions. Instead of asking "How many... ", an analyst is now asking "When will... ". To answer these questions, imagery analysts need to be multidisciplinary experts or have access to experts in many specialized disciplines. Analysts need to engage these experts in conversation to utilize their knowledge in a particular domain to solve a problem or provide reference within a technical field unfamiliar to the analyst.

One way to deal with this need for access to domain experts is via knowledge based systems and/or expert systems. These systems provide a mechanism for capturing, organizing and representing domain knowledge in the absence of the experts themselves and to preserve domain knowledge when an expert moves to a new job or retires. It also allows for the synergistic use of multiple expert's knowledge so that the whole are greater than the parts.

As one might expect, the information used in imagery analysis is very multimedia oriented. The forms of media include imagery, graphics, motion imagery (video), text, audio and animation (models and simulation). The user interface involved in merging these multimedia sources with expert domain knowledge and presenting them to an imagery analyst is also and R&D issue.

Objectives:

The objectives of this program are: (1) to determine how to build knowledge-based and expert systems for use in supporting imagery analysis, (2) to create tools to assist the knowledge engineer capture domain specific information and build the knowledge base, and (3) to integrate multimedia information in a user-friendly, human-computer interface.

Impact:

This program has the potential to break the physical ties that imagery analysts have with the experts that provide consultation and reference information. Imagery analysts are limited today by the amount of time experts can provide to consult on problems, their availability and schedule, and the costs associated with their time. This break will improve the timeliness and hopefully the reliability of their analysis and thereby improve the intelligence provided to policymakers and commanders.

Area 3: Intelligent Agents

Background

An agent is a dynamic software entity that is self-contained and performs tasks on behalf of a user or user-initiated process. Agents embody different qualities depending on their abilities and the different functions associated with their activities. Most agents have qualities such as: autonomy- the ability to operate without the intervention of humans or other agents, social ability – the ability to interact with humans or other agents, and reactivity – the ability to perceive their environment and respond to changes in it. Software agents have moved beyond the hype phase and are showing promise in many different domains and industries.

Large, dynamic, complex and distributed applications are excellent targets for utilizing software agents. As the Intelligence community moves into a new era of collection systems, the Imagery

and Geospatial Community (IGC) analysts will have more volume of source data, increased complexity of information, and more detailed questions to answer for decision makers and commanders in the field. Intelligent software agents provide a technology which can assist an analyst organize, retrieve, pre-screen, update databases, and communicate with other analysts or agents on behalf of other analysts. This technology has the potential to decrease the cycle-times in producing information for our customers.

Objectives

The objectives of this program are: (1) to determine how and where intelligent agent technology can be applied to assist imagery and geospatial analysis; (2) to further the research in areas relevant to application within NIMA and the IGC; and (3) to apply the technology to a problem set of interest to NIMA.

Impact

Agents and intelligent systems are among the most promising approaches for managing the dramatically increased amounts of data available to enterprises. An enterprise like NIMA and the IGC can leverage this technology for faster assimilation and distribution of relevant information as both a producer and consumer of information. The NIMA enterprise needs to position itself to be ready for the next wave of office automation and mission-specific automation (e.g., automated decision support in workflow, knowledge and network management, and decision support).

The Gartner Group identifies the following areas for application of agents and intelligent systems, many of which are relevant to NIMA:

- Information retrieval (personalized agents that understand users' interest profiles and submitted requests, and go out on the web and retrieve and rank results)
- Monitoring and diagnosing (systems that watch streams of data for certain conditions and possibly act on them)
- Office automation (supporting routing processes, e.g., scheduling, calendaring, e-mail filtering)
- Interfacing humans and machines: adaptive interfaces, machine translation
- Planning, scheduling, load balancing, design, classification and so on

Research Topic Chief: Mr. Jeffrey Fleisher (NIMA/TEP), (301) 227-7452, FleisheJ@nima.mil

NIMA Research Area: NEUROSCIENCE

Background:

Advances in optics, sensors, electronics, and communications technologies have resulted in a flood of national, military, and commercially available imagery to image and geospatial analysts. Relative to the size of the investment made to date on automatic target recognition (ATR)

algorithms, few ATR tools are available to help these analysts. A reason for this may be the bottom-up, pixel-based approach historically taken by computer vision researchers. We know that target recognition is not impossible since biological organisms (e.g., humans) are existence proofs. Biological organisms have evolved the ability to locate targets (e.g., food) in a very complex natural environment, even defeating evolutionarily developed camouflage, concealment, and deception (CC&D).

Objectives:

This research program will provide understanding and technology to facilitate Human Target Recognition (HTR) and develop novel, biologically inspired ATR approaches.

Research Concentration Areas:

Area 1: Human Target Recognition

Expert image and geospatial analysts are amazingly quick and accurate at identifying salient target features in panchromatic still and video imagery. The goals of this portion of the research program are to understand the innate abilities and limitations of analysts, offer better computer-assisted tools, and identify effective training approaches for target detection. Of particular interest is non-literal imagery, i.e., what is non-literal for humans is normal for some biological organisms. Can we process and display non-literal imagery data better for human analysts?

Area 2: Automated Target Recognition

Neuroscience research has matured enough to develop sophisticated functional models gleaned from physiological studies. The goals of this portion of the research program are to identify new approaches to ATR from the knowledge of biologically employed features, identify new ATR computational architectures, and demonstrate computational models for single or multiple sensor modalities.

Impact:

This research program will provide understanding and technology to improve NIMA's productivity in providing imagery intelligence and geospatial information.

Research Topic Chief: Mr. Robert Mericsko (NIMA/TER), (202) 314-5612, MericskB@nima.mil

NIMA Research Area: IMAGE SCIENCES

Background:

Imagery collection, exploitation and data analysis are technologies critical to NIMA. Imagery systems cannot simply be treated as another form of digital data since they interact with the visual system of the human analyst. Digital data extraction requires human analyst perception and manipulation. Interpretation and manipulation is increasingly being performed on digital imagery workstations, as collection systems transition to an all-digital technology base. Most of

the knowledge of human and machine interaction used today in exploiting imagery were developed during a period in which imagery was exploited in a hard copy film form. Imagery resolution scales and exploitation criteria were all established within a hard copy (film) source environment.

Objectives:

This research program will provide knowledge and technology to facilitate the extraction, compilation and visualization of information derived from digital imagery sources.

Research Concentration Areas:

Area 1: Imagery quality evaluation

An assessment of existing image quality metrics and their relevance to the future all-digital imagery environment is needed. The creation of new metrics, if needed, is required for future digital imagery data sources. Research into the effects of digital displays, compression, and other image chain parameters to the interpretability of information content in the all-digital environment is also needed.

Area 2: Image processing

Image processing for improving the information content of a scene (image) for human and/or machine processing will become more important as imagery from non-literal sensors becomes more prevalent. Research into techniques to characterize a scene and improve the information content for future human processing or prior to machine processing is needed. Research into data and information compression from non-literal sensors is also needed.

Area 3: Printing Sciences

Hard copy maps will continue to play a major role well into the first decade of the next century. These products must be compiled over very short timelines and tailored to meet a particular objective. Research into the technology available to meet these objectives will lay the groundwork for future capabilities. The research should review and recommend the limitations of accomplishing these goals today and the technological path that should be followed by NIMA to enable the capability in the future without loss of accuracy or content. Research into optimum color combinations and rapid printing technologies that allow for maximum information content in minimum time is needed.

Area 4: Videogrammetry

Traditional methods of photogrammetry are used to extract 3-dimensional information from stereo-pair photography. Video source materials from airborne or land-based remotely-piloted vehicles provide an extremely large number of individual frames from progressively changing viewpoints. These images typically have a high-resolution view of the ground and often dwell over the same area for extended periods, revisiting sites repeatedly from different points of view. This imagery could be used for developing very high resolution terrain elevation data, for high resolution feature extraction, for wire frame site model building, and for other geospatial or intelligence needs for which high precision and high accuracy geolocations and measurements are required. Research is needed in mathematical approaches and processing algorithms to efficiently provide image-object geolocation and dimension information, and platform exploitation support data, from video imagery.

Impact:

These efforts are the building blocks to better optimize the relationship between our imagery, map and chart users and the analytical production processes.

Research Topic Chief: Mr. Ray Unger (NIMA/TEP), (202) 863-3695, UngerR@nima.mil

NIMA Research Area: MATHEMATICS

Background:

Unlike subjects such as GIS and geodesy, NIMA does not have an intrinsic interest in mathematics, only in what mathematics can do for applications in which NIMA does have a direct interest (for example, in areas of GIS and geodesy). Thus research within the Mathematics area must tie very closely with the ultimate application area.

NIMA is responsible for generating various densities of Digital Terrain Elevation Data (DTED) and grids of other geophysical data, such as deflections of the vertical. Typically such datasets are produced on grids of equal arc spacing in latitude and longitude. Such a scheme does not lend itself to efficient storage and representation of the data, since large regions which are relatively featureless must be stored at the density required for the most detailed regions. Furthermore, requirements for high-resolution gridded data over very localized areas are increasing dramatically. This increases the burden on storage and dissemination systems.

Wavelets have been a topic of interest in both mathematical research and scientific applications in the last 20 years. They have been shown to have value in signal processing because of their excellent localization properties. Wavelets appear to have application in at least two areas of particular interest to NIMA.

Objectives:

NIMA is interested in studies that evaluate the feasibility of wavelets or other transformations, refinement schemes or combinatorial strategies to achieve improved representations, and more efficient storage, management and dissemination, for gridded data sets.

Research Concentration Areas:

Area 1: Digital Terrain Elevation Data

NIMA is interested in investigations of wavelet-based technologies, refinement schemes and combinatorial strategies for devising an adaptive scheme for representing gridded data sets. In particular, near-lossless (precision and accuracy) compression of existing gridded sets data such as DTED might be possible. To be included must be an understanding of the effects on errors propagated through such new schemes.

Area 2: Geodesy

Currently, spherical harmonic expansions of degree and order 360 are used to model the gravity field of the Earth. These expansions suffer from the same drawbacks as gridded representations of the data, namely that increasing the resolution in one location essentially requires the resolution to be increased globally. Studies have shown the potential for wavelets to be used in gravity field modeling. The goal here is to extend or improve current results to a universal scheme for modeling the geopotential in a wavelet basis.

Impact:

Successful work in these enabling technologies will extend or improve current results with the ultimate goal of defining more universal schemes for modeling, representing, storing, managing and disseminating gridded data.

Research Topic Chief: Dr. Paul Salamonowicz (NIMA/TEP), (703) 262-4575, SalamonP@nima.mil

NIMA Research Area: TECHNOLOGY TRANSFER

Background:

NIMA sponsors a significant amount of research and development and often achieves success at the component level. However, the return on these investments cannot be realized until the changes are introduced and implemented in the Agency's workflow processes. Due to the structure and size of the organization, this usually necessitates a handoff of technology from the development teams to an acquisition group, or directly to Operations. Both programmatic and sociological barriers inhibit this transition.

Objectives:

Design an R&D process the enables technology transfer across organizational borders.

Impact:

Success in this research project area will have immediate and long-lasting real dollar cost savings, as well as expediting the transfer and use of new technology in NIMA operational environments.

Research Topic Chief: Mr. Sam Grant (NIMA/TEP), (703) 262-4572, GrantS@nima.mil

IX. SIGNIFICANT DATES

The following table posts the significant dates referred to in the body of this announcement .

Action	<u>Responsibility</u>	Due Date
--------	------------------------------	----------

Issue announcement in Commerce Business Daily	Government	09/27/99
White Paper due (optional)	Principal Investigator	17:00 EDT 10/19/99
Notification to proceed (where required)	Government	10/29/99
Proposal due	Principal Investigator	17:00 EST 11/18/99
Acknowledge receipt of proposals	Government	11/23/99
Letter of intent to recommend for award	Government	12/16/99
Start date	Principal Investigator	01/01/00

APPENDIX A: LATE SUBMISSIONS

Per the Federal Acquisition Regulation part 52.215-10, Sections (a) (1) through (a) (5):

"Any proposal received at the office designated in the solicitation after the exact time specified for receipt will not be considered unless it is received before award is made and it

"(1) Was sent by registered or certified mail not later than the fifth calendar day before the date specified for receipt of offers (e.g., an offer submitted in response to a solicitation requiring receipt of offers by the 20th of the month must have been mailed by the 15th);

"(2) Was sent by mail or, if authorized by the solicitation, was sent by telegram or via facsimile and it is determined by the Government that the late receipt was due solely to mishandling by the Government after receipt at the Government installation;

"(3) Was sent by U.S. Postal Service Express Mail Next Day Service-Post Office to Addresses, not later than 5:00 p.m. at the place of mailing two working days prior to the date specified for receipt for proposals. The term "working days" excludes weekends and U.S. Federal Holidays;

"(4) Was transmitted through an electronic commerce method authorized by the solicitation and was received by the Government not later than 5:00 pm one working day prior to the date specified for receipt of proposals; or

"(5) Is the only proposal received."

Contracts: <u>Eileen Frazier</u>, Phone: 301-227-5341 Technical: <u>Richard Berg</u>, Phone: 301-227-7498 Revised: 09.21.99