Office of Science
Financial Assistance
Funding Opportunity Announcement
DE-PS02-09ER09-10

Mathematics for Analysis of Petascale Data

SUMMARY:

The Office of Advanced Scientific Computing Research (ASCR) of the Office of Science (SC), U.S. Department of Energy (DOE), hereby announces its interest in receiving grant applications for research addressing the mathematical challenges involved in extracting insights from extremely large datasets ("petascale data") and investigating fundamental issues in finding key features and understanding the relationships between those features.

Petascale data may be produced by high-resolution simulations on massively parallel computers in complex applications, such as climate modeling, fusion, and other large-scale science and engineering calculations. They may also result from experiments and observational studies, such as those in high-energy physics and cosmology. The effective analysis of petascale data is often challenged by some combination of its large-scale, distributed, heterogeneous, and varying statistical properties. Novel mathematical models, methods, and tools are needed for the representation, analysis, and understanding of such large-scale datasets that come from scientific domains pertinent to the DOE.

All applications should address the potential for advances in mathematical methods or numerical algorithms and not just the application of methods and algorithms to a specific science problem, no matter how challenging. Educational aspects, while always welcome, are neither required nor emphasized in this call.

More information on this solicitation is provided in the Supplementary Information below.

LETTER OF INTENT DUE DATE: April 15, 2009, 4:30pm, Eastern Time

A one-page Letter of Intent (LOI) to submit an application **is REQUIRED** and must be received by April 15, 2009, 4:30pm Eastern Time. The Letter of Intent should be submitted by e-mail as a PDF file attachment to: appliedmath@ascr.doe.gov. Please use "Letter of Intent for Announcement DE-PS02-09ER09-10" in the subject line.

The purpose of the Letter of Intent (LOI) is to facilitate the planning of the peer review process and the selection of reviewers, including identifying any potential conflicts of interest. The one-page LOI must include the following information:

- the announcement number DE-PS02-09ER09-10;

- name, institutional affiliation, e-mail address, and phone number for the Principal Investigator (PI);
- name, institutional affiliation, and e-mail address of other PIs and senior personnel;
- project funding request (approximate);
- title of the proposed effort;
- and an abstract of the proposed research.

For collaborations involving multiple institutions, a single LOI should be submitted by the PI of the lead institution. An example of the format for the one-page LOI can be viewed at: http://www.science.doe.gov/ascr/Research/LOI_MAPD.pdf.

A response to the Letters of Intent encouraging or discouraging formal applications will be communicated to the applicants by April 24, 2009. Formal applications will be accepted only from those encouraged to submit. No other formal applications will be considered.

APPLICATION DUE DATE: May 29, 2009, 8 PM Eastern Time.

Formal applications submitted in response to this Announcement must be received by May 29, 2009, 8:00 p.m. Eastern time, to permit timely consideration of awards. **You are encouraged to transmit your application well before the deadline. APPLICATIONS RECEIVED AFTER THE DEADLINE WILL NOT BE REVIEWED OR CONSIDERED FOR AWARD.**

ATTENTION - CHANGE IN SUBMISSION REQUIREMENT EFFECTIVE March 12, 2009

The Office of Science is now requiring all financial assistance applications be submitted through the Department of Energy e-Center (IIPS) http://doe-iips.pr.doe.gov/. Applicants will still need to visit the Grants.gov website http://www.grants.gov/ to download the required Application Package (forms), by clicking on "Apply for Grants" and searching for the Funding Opportunity Announcement.

For Instructions on the Use of IIPS visit this web page, IIPS Instructions. http://www.sc.doe.gov/grants/iips-Instructions.html.

Registration Requirements: There are several one-time actions you must complete in order to submit an application through Grants.gov (e.g., obtain a Dun and Bradstreet Data Universal Numbering System (DUNS) number, register with the Central Contract Registry (CCR), register with the credential provider, and register with Grants.gov). See http://www.grants.gov/GetStarted. Use the Grants.gov Organization Registration Checklist at http://www.grants.gov/assets/OrganizationRegCheck.doc to guide you through the process. Designating an E-Business Point of Contact (EBiz POC) and obtaining a special password called an MPIN are important steps in the CCR registration process. Applicants, who are not registered with CCR and Grants.gov, should allow at least 21 days to complete these requirements. It is suggested that the process be started as soon as possible.

FOR FURTHER INFORMATION CONTACT: Alexandra Landsberg, Applied Mathematics Program, Telephone: (301) 903-8507, FAX: (301) 903-7774, E-mail: landsberg@ascr.doe.gov.

SUPPLEMENTARY INFORMATION:

The analysis of large-scale datasets has become increasingly difficult due to the complexity and enormous volume of data obtained from observatories, experimental facilities, and computational simulations. DOE scientists need to address the daunting challenges in extracting scientific knowledge from petascale data, and mathematical methods have long been the mainstay for such efforts. Over the next decade, many existing approaches for data analysis will fail to provide adequate robustness, scalability, and combinatorial tractability. The Applied Mathematics Program within the Office of Advanced Scientific Computing Research supports basic research on the mathematical methods and numerical algorithms that address these long-term needs. This Announcement solicits innovative basic research applications in mathematics for petascale data analysis. Particularly innovative approaches for supporting mathematical research efforts, including but not limited to workshops and conferences, will also be considered under this solicitation.

Prospective research should observe that:

- Collaborative applications involving multiple institutions, which may include universities, laboratories, and/or private institutions, are encouraged but not required.
- Proposed research activities should be relevant to the mission of the Department of Energy and, in particular, to the long-term goals of its research programs.
- No funds will be provided to Federal Laboratories and Federally Funded Research and Development Centers (FFRDCs), including the DOE National Laboratories, under this Announcement. Laboratories should respond to the LAB 09-10 Announcement posted at: http://www.science.doe.gov/grants/grants.html
- Researchers may request a period of performance of up to three (3) years.

This solicitation seeks applications for basic research in mathematical models, methods and tools for the representation, analysis, and understanding of petascale data. Areas of interest include, but are not limited to:

- Novel mathematical techniques and algorithmic approaches to build and evaluate appropriate models from large-scale, heterogeneous, high-dimensional data.
- New algorithms designed to scale with the size of the data, which is often independent of the number of model parameters, and so may require parallel, single-pass, or subsampling methodologies.
- Methodologies for analyzing data, distributed over space and time, with changing local properties that may not statistically resemble the global properties of the data.
- The development of real-time anomaly identification in streaming and evolving data for detecting and responding to interesting phenomena that may be short-lived or urgent.
- Novel mathematical approaches to improve the methods of collection for petascale data, and dimension reduction for extracting pertinent subsets, features of interest, or low-dimensional patterns.
- The development of rigorous mathematical approaches for combining data of different types and quality (e.g., noisy or incomplete data), and that can also quantify the various forms of uncertainties in the data.

- Rigorous mathematical methods for identifying important features in complex data, such as time-dependent scalar, vector, and tensor field data.

For more information on petascale data challenges and scientific examples of interest to DOE, see the following reports -

- Mathematics for Analysis of Petascale Data Workshop Report http://www.sc.doe.gov/ascr/ProgramDocuments/Docs/PetascaleDataWorkshopReport.pdf
- Visualization and Knowledge Discovery: Report from the DOE/ASCR Workshop on Visual Analysis and Data Exploration at Extreme Scale http://www.sc.doe.gov/ascr/ProgramDocuments/Docs/DOE-Visualization-Report-2007.pdf
- Applied Mathematics at the U.S. Department of Energy: Past, present and a view to the future http://www.sc.doe.gov/ascr/ProgramDocuments/Docs/Brown_Report_May_08.pdf

Collaboration and Communication

The application should identify potential collaborations or other interactions that will facilitate the exchange of ideas and dissemination of information among research centers in industry, universities, and/or laboratories. Synergistic collaborations with researchers in Federally Funded Research and Development Centers (FFRDCs), including the DOE National Laboratories, are also encouraged, though no funds will be provided to these organizations under this Announcement. Further information on preparation of collaborative applications may be accessed via the Internet at http://www.science.doe.gov/grants/colab.html.

ESTIMATED FUNDING

It is anticipated that up to $4 million total will be available for multiple awards for this solicitation in Fiscal Year 2009. Proposers may request project support for up to three years. All awards are contingent on the availability of funds and programmatic needs. DOE is under no obligation to pay for any costs associated with the preparation or submission of an application. DOE reserves the right to fund, in whole or in part, any, all or none of the applications submitted in response to the Announcement.

MERIT REVIEW CRITERIA

Applications will be subjected to scientific merit review (peer review) and will be evaluated against the following evaluation criteria, which are listed in descending order of importance codified at CFR 605.10(d):

1. Scientific and/or Technical Merit of the Project
2. Appropriateness of the Proposed Method or Approach
3. Competency of Applicant's Personnel and Adequacy of Proposed Resources; and
4. Reasonableness and Appropriateness of the Proposed Budget.

The evaluation process will include program policy factors, such as the relevance of the proposed research in terms of the solicitation and the agencies' programmatic needs. Note that

external peer reviewers are selected with regard to both their scientific expertise and the absence of conflict-of-interest issues. Both Federal and non-Federal reviewers may be used, and submission of an application constitutes agreement that this is acceptable to the investigator(s) and the submitting institution.

The Catalog of Federal Domestic Assistance (CFDA) number for this program is 81.049, and the solicitation control number is ERFAP 10 CFR Part 605.

Posted on the Office of Science Grants and Contracts Web Site
March 31, 2009.