Preview of Award 1229408 - Annual Project Report

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Cover

Federal Agency and Organization Element to Which Report is Submitted:	4900
Federal Grant or Other Identifying Number Assigned by Agency:	1229408
Project Title:	MRI: Aquisition of Computer Cluster for Heliophysics, Plasma, and Turbulence Modeling
PD/PI Name:	Joachim Raeder, Principal Investigator
Recipient Organization:	University of New Hampshire
Project/Grant Period:	09/01/2012 - 08/31/2016
Reporting Period:	09/01/2014 - 08/31/2015
Submitting Official (if other than PD\PI):	N/A
Submission Date:	N/A
Signature of Submitting Official (signature shall be submitted in accordance with agency specific instructions)	N/A

Accomplishments

*** What are the major goals of the project?**

Acquire and operatea computer cluster for space plasma research.

*** What was accomplished under these goals (you must provide information for at least one of the 4 categories below)?**

Major Activities: We continue to operate the computer, a Cray XE6m-200 with 4226 cores, named "Trillian". Trillian has been up and running virtually contiuously and provides compute cycles and data storage for many projects.

Specific Objectives: Our soecific objective is to keep Trillian operational with minimal interruptions and accessible for researchers, including students, to pursue their work. Trillian's uptime is better than 98%, with minimal interruptions due to technical glitches and maintenance work. Trillian's utilization rate is of the order of 70%, but with major annual, and even weekly variations. However, most of the time, users do not need to wait to have their compute jobs executed. This strikes a good balance between accessibility and utilization. By contrast, large computer centers often have near 100% utilization, but at the price of long wait queues, with reduced scientific productivity. A yearly/montly breakdown of usage is provided as a separate table since the research.gov site does not allow proper formatting of tables with a fixed-width font. There are about 50 users on Trillian, most of them students.

At peak rate, Trillian would deliver approximateyl 36 million core-hours (SU) per year. At ~70% utilization, Trillian has delivered ~56 million SU over the roughly two-year periood since it entered service. This is a significant amount of computational power, which would be difficult to obtain otherwise, such as at national computer centers. It would have required numerous proposals, with uncertain outcome, since computer time is usually only granted for one year, and not obtaing the requested time can lead to a significant impact on research productivity. By contrast, Trillian provides a much more reliable resource. Furthermore, remote computing requires huge data transfers that saturate networks. Many research activities would be difficult, delayed, or simply impossible due to network constraints. Trillian's storage capacity is ~160 TB. Transferring that amount of data, at 10 MB/s, would require ~180 days. Since there is a significant turnover of the stored data (old runs dicarded for newer runs), nwtwork capacity alone would be a major bottleneck.

Significant Results: Results come from the research conducted using Trillian and is reported below in the "dissemination" section.

Key outcomes or
Other achievements:

*** What opportunities for training and professional development has the project provided?**

Our system operators received training from Cray Inc on all aspects of administration and maintenance of the computer. A significant number of students, researchers, and faculty get direct access to a supercomputing resource.

*** How have the results been disseminated to communities of interest?**

Work conducted useing Trillian has resulted in a significant number of publications and theses, which are listed here. For journal publications we list the digital object identifier (DOI), the first author, and the journal. Detailed information can be obtained by using the DOI at www.doi.org.

1. DOI:10.1063/1.4906063 L. Wang, Phys. Plas.
2. DOI:10.1002/2013JA019551 Q. Q. Shi, JGR
3. DOI:10.1002/2015JA021156 H. K. Connor, JGR
4. DOI:10.1088/0004-637X/806/1/33 B. Vasquez, Ap. J.
5. DOI:10.1088/0004-637X/808/2/119 P. Isenberg, Ap. J.
6. DOI:10.1002/2014SW001086 N. Schwadron, Space Weather
7. DOI:10.1002/2013SW000997 C. Joyce, Space Weather

8. DOI:10.1126/science.1245026 N. Schwadron, Science
9. DOI:10.1088/0004-637X/810/2/97 N. Schwadron, Ap. J.
10. DOI:10.1103/PhysRevLett.113.105003 G. Fiskel, Phys. Rev. Lett.
11. DOI:10.1063/1.4906063 L. Wang, arXiv.org
12. DOI:10.1017/jfm.2014.285 E. Brand, J. Fl. Mech.
13. DOI:10.1017/jfm.2014.8 J. Gibson, J. Fl. Mech.
14. DOI:10.1002/2015JA021147 D. Oliveira, JGR

Ph.D. thesis: "Kelvin-Helmholtz Instability at Earth's magnetopause: THEMIS Observations and OpenGGCM Simulations",
S. Kavosi, 2015.

Ph.D. thesis: "A study of interplanetary shock geoeffectiveness controlled by impact angles using simulations and observations", D. G. Oliveira, UNH, 2015.

Ph.D. thesis: "Diamagnetic Stabilization of Double-tearing Modes in MHD Simulations", Stephen Abbott, UNH, 2015.

Ph.D. thesis: "The directed molecular self-assembly of a novel pentacene derivative on gold surfaces: an experimental and computational study", Amanda Larson, UNH, 2015.
(comment: this thesis won the Wayne B. Nottingham Prize at this year's 75th annual Physical Electronic Conference held at Rutgers and Bell labs, June 17-19, 2015,
see: https://en.wikipedia.org/wiki/Wayne_B._Nottingham_Prize)

*** What do you plan to do during the next reporting period to accomplish the goals?**

We plan to keep operating Trillian without any major changes.

Supporting Files

Filename	Description	Uploaded By	Uploaded On
table-usage-2015.pdf	Table detailing Trillian usage.	Joachim Raeder	10/08/2015

Products

Books

Book Chapters

Conference Papers and Presentations

Inventions

Journals

Licenses

Other Products

Other Publications

Patents

Technologies or Techniques

Thesis/Dissertations

Websites
Trillian
http://trillian-use.sr.unh.edu/index.php/Main_Page

Trillian, a CRAY XE6m-200 at UNH for the simulation of space plasma and fluid flow

Participants/Organizations

What individuals have worked on the project?

Name	Most Senior Project Role	Nearest Person Month Worked
Raeder, Joachim	PD/PI	1
Baker, Thomas	Technician	1
Maciolek, Mark	Technician	1

Full details of individuals who have worked on the project:

Joachim Raeder
Email: J.Raeder@unh.edu
Most Senior Project Role: PD/PI
Nearest Person Month Worked: 1

Contribution to the Project: Management.

Funding Support: TT faculty

International Collaboration: No
International Travel: No

Thomas Baker
Email: tjb@unh.edu
Most Senior Project Role: Technician
Nearest Person Month Worked: 1

Contribution to the Project: System administrator / programmer

Funding Support: this grant, UNH/SVPR office

International Collaboration: No
International Travel: No

Mark Maciolek
Email: mlm@blackstar.sr.unh.edu
Most Senior Project Role: Technician
Nearest Person Month Worked: 1

Contribution to the Project: managing CRAY installation, network management

Funding Support: this grant

International Collaboration: No
International Travel: No

What other organizations have been involved as partners?
Nothing to report.

What other collaborators or contacts have been involved?
Nothing to report

Impacts

What is the impact on the development of the principal discipline(s) of the project?

Trillian supports numerous projects by providing computer power for large-scale plasma simulations.

What is the impact on other disciplines?

We occasionally grant excess cycles to other UNH researchers (ocean science, engineering), whose projects benfit from Trillian.

What is the impact on the development of human resources?

Trillian has been used in classroom instruction for HPC courses (IAM 851). 31 users are students, and 13 users are post-docs or staff researchers, who get first-hand experience in high-performance computing.

What is the impact on physical resources that form infrastructure?

Trillian significantly contributes to UNH's research and teaching infrastructure.

What is the impact on institutional resources that form infrastructure?

The installation of Trillian has prompted the University to improve infrastructure, such as cooling and power.

What is the impact on information resources that form infrastructure?

Since Trillian also requires network bandwidth, the university has made substantial investments in that area.

What is the impact on technology transfer?
Nothing to report.

What is the impact on society beyond science and technology?
Nothing to report.

Changes/Problems

Changes in approach and reason for change
Nothing to report.

Actual or Anticipated problems or delays and actions or plans to resolve them
Nothing to report.

Changes that have a significant impact on expenditures

Nothing to report.

Significant changes in use or care of human subjects
Nothing to report.

Significant changes in use or care of vertebrate animals
Nothing to report.

Significant changes in use or care of biohazards
Nothing to report.

Special Requirements

Responses to any special reporting requirements specified in the award terms and conditions, as well as any award specific reporting requirements.
Nothing to report.