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Preview of Award 1261653 - 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:	1261653
Project Title:	Acquisition of Next Generation Terrestrial Laser Scanning Systems for Community Earth and Polar Science Research
PD/PI Name:	Glen S Mattioli, Principal Investigator Peter LaFemina, Co-Principal Investigator Charles M Meertens, Co-Principal Investigator
Recipient Organization:	UNAVCO, Inc.
Project/Grant Period:	04/01/2013 - 03/31/2016
Reporting Period:	04/01/2014 - 03/31/2015
Submitting Official (if other than PD\PI):	Glen S Mattioli Principal Investigator
Submission Date:	03/31/2015
Signature of Submitting Official (signature shall be submitted in accordance with agency specific instructions)	Glen S Mattioli

Accomplishments

* What are the major goals of the project?

In recent years, Terrestrial Laser Scanning (TLS) has established itself as a valuable scientific tool for Earth science research. TLS uses Light Distance and Ranging (LiDAR) technology and is also referred to as ground-based LiDAR or tripod LiDAR. The primary capability of TLS is the generation of high-resolution 3-dimensional (3D) imagery of surfaces and objects over scales of meters to kilometers with sub-centimeter to centimeter resolution and precision. This allows for accurate mapping of geologic features, and determination of change of these features over time via repeated measurements. The

incorporation of GPS measurements with TLS observations provides georeferencing of TLS data in an absolute reference frame. The addition of digital photography yields photorealistic 3D images. TLS systems are portable and suitable for a wide spectrum of user applications in a variety of environments. TLS resources at UNAVCO are currently overextended because of steadily increasing demand for support and the recent retirement of the sole UNAVCO Polar TLS instrument.

The project - *Acquisition of Next Generation Terrestrial Laser Scanning Systems for Community Earth and Polar Science Research* – was funded through the NSF EAR-IF program to acquire two new terrestrial laser scanning (TLS) instrument systems for the UNAVCO community equipment pool. These TLS systems will be shared resources managed by UNAVCO Facility and integrated into UNAVCO's ongoing support for NSF Polar (PLR) and Earth science (EAR) projects. The new TLS instruments will be critical resources for the Geodetic Imaging group within the Geodetic Infrastructure program under the Geodesy Advancing Geoscience and EarthScope (GAGE) Facility Cooperative Agreement (EAR-1261833) from 2013-2018. Considering the expense of TLS instruments and the expertise needed for their successful operation, this approach represents the most cost effective means of maximizing return on investment and making this technology accessible to the NSF EAR and PLR research communities. Related services also provided by UNAVCO EAR and PLR include access to the GPS instrument pool, pre-season project planning, logistical support, field support and training, data management and archiving, post-season follow-up and research and development work for supporting new applications.

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

Major Activities:

In May 2013, the first TLS system was acquired under this award. A Riegl VZ1000 laser scanner, integrated camera system, associated accessories, and field computer were acquired from Riegl USA. Funds from this award were also utilized to upgrade one of UNAVCO's existing Riegl VZ400 systems to add a digital compass and hardware support for the integration of an RTK GPS antenna directly into the scanner. This upgrade represents an important modernization of UNAVCO's existing TLS systems, and it ensures that this TLS instrument remains useful to the EAR and PLR communities.

During the reporting period, the new Riegl VZ1000 TLS system was used to support greater than half a dozen TLS projects – five NSF EAR or other funded projects and several NSF PLR projects in polar regions.

The primary activity during the reporting period was the evaluation and determination of a second TLS system to acquire under the existing award. UNAVCO issued a public RFQ for terrestrial laser scanning systems

(<http://www.unavco.org/contact/procurement/solicitations/2014/RFQ-Q120913%20TLS%20040414.pdf>) and received responses from three manufacturers: Maptek, Optech, and Riegl. A total of six instruments were covered by the three responses (Riegl has four instruments that met the criteria defined in the RFQ).

An evaluation committee, composed of five UNAVCO staff, was established to review and evaluate the RFQ responses. Each vendor came to Boulder and performed a one-day demonstration of their hardware and software, including a scanning demo at the NCAR Mesa Lab. Riegl visited Boulder twice to demonstrate two different TLS systems. The evaluation committee reviewed each scanner based on ten agreed upon criteria as well as the system specifications defined in the RFQ.

A complete seven-page report documents the TLS system evaluation process, the evaluations, and the outcomes. This report was then shared with the PIs of the instrument acquisition award as well as UNAVCO's six-member Terrestrial Imaging Geodesy Working Group (TIGWiG) for further input.

The conclusions of the TLS RFQ evaluation committee were that UNAVCO should proceed with the acquisition of another Riegl system, either a VZ-1000, VZ-2000, or a VZ-4000. Upon further input from the PIs of this award, UNAVCO senior management,

and the TIGWiG review, as well as an evaluation of remaining budget, the conclusion was made that a Riegl VZ-2000 has the best technical capabilities to support the NSF EAR and PLR science communities.

Specific Objectives: The primary objective during this reporting period was to complete a public RFQ for terrestrial laser scanning systems (<http://www.unavco.org/contact/procurement/solicitations/2014/RFQ-Q120913%20TLS%20040414.pdf>) and to thoroughly evaluate all responses from potential vendors.

Significant Results: Completed RFQ and evaluation with a conclusion to proceed with the acquisition of a Riegl VZ-2000 TLS system.

Key outcomes or Other achievements: Nothing to report.

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

As part of the scanner RFQ, manufacturers came to Boulder and performed a one-day demonstration of their hardware and software, including a scanning demo at the NCAR Mesa Lab. This is a valuable opportunity for UNAVCO staff to remain current on TLS technologies and the various systems on the market. Five UNAVCO staff participated in the demos.

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

Outreach to the UNAVCO community to make them aware of new TLS resources has primarily been through presentations at national meetings, for example the GSA Annual Meeting in Denver in 2013 and in Vancouver, BC in 2014 and the Annual AGU Meeting in San Francisco in 2013 and 2014. PIs soliciting UNAVCO TLS project support are also briefed on instrument resources during consultations with the Geodetic Imaging Project Manager. The UNAVCO Geodetic Imaging website and knowledge base have been updated with information on the new instrumentation, as well.

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

UNAVCO is in the process of submitting the requisition to purchase a VZ-2000 from Riegl and expect the instrument to be in house in time for the busy summer TLS project support period.

Products

Books

Book Chapters

Conference Papers and Presentations

Inventions

Journals

Licenses

Other Products

Other Publications

UNAVCO staff (2014). *Riegl TLS Field Operation Manual and Workflow Manual*. developed by UNAVCO staff to document our best-practices for Riegl terrestrial laser scanner field operation, data collection, and initial data processing. This document is for a tie-point based workflow, using the Riegl VZ1000, VZ400, and Z620 scanners. The UNAVCO Riegl TLS

manual is detailed enough to guide a user through the standard data collection workflow; accordingly, we recommend it as a resource for UNAVCO community members working with UNAVCO all Riegl scanners.. Status = PUBLISHED;
Acknowledgement of Federal Support = Yes

Patents

Technologies or Techniques

Thesis/Dissertations

Websites

UNAVCO Knowledgebase

<http://facility.unavco.org/kb>

UNAVCO searchable knowledgebase

UNAVCO website

<http://www.unavco.org>

Main UNAVCO website

Participants/Organizations

What individuals have worked on the project?

Name	Most Senior Project Role	Nearest Person Month Worked
Mattioli, Glen	PD/PI	0
LaFemina, Peter	Co PD/PI	0
Meertens, Charles	Co PD/PI	0
Crosby, Christopher	Other Professional	1

Full details of individuals who have worked on the project:

Glen S Mattioli

Email: gmattioli@uta.edu

Most Senior Project Role: PD/PI

Nearest Person Month Worked: 0

Contribution to the Project: As Geodetic Infrastructure Director I am responsible for the physical assets in the TLS program as well as indirect supervision and prioritization of the field engineering resources used to support EAR and PLR projects.

Funding Support: GAGE Facility Cooperative Agreement

International Collaboration: No

International Travel: No

Peter LaFemina

Email: plafemina@geosc.psu.edu

Most Senior Project Role: Co PD/PI

Nearest Person Month Worked: 0

Contribution to the Project: Chair of the UNAVCO Board of Directors and former member of the Facility Advisory Committee.

Funding Support: Non-UNAVCO sources.

International Collaboration: No

International Travel: No

Charles M Meertens

Email: meertens@unavco.org

Most Senior Project Role: Co PD/PI

Nearest Person Month Worked: 0

Contribution to the Project: Director of Geodetic Data Systems at UNAVCO. In this role, he indirectly supervises the Imaging Geodesy group at UNAVCO, which includes Chris Crosby.

Funding Support: GAGE Facility Cooperative Agreement

International Collaboration: No

International Travel: No

Christopher Crosby

Email: crosby@unavco.org

Most Senior Project Role: Other Professional

Nearest Person Month Worked: 1

Contribution to the Project: Project manager for geodetic imaging. Managed the acquisition of the terrestrial laser scanner purchased under this award. He also commissioned the instrument and managed its use in PI field projects.

Funding Support: NSF GAGE Facility Award

International Collaboration: No

International Travel: No

What other organizations have been involved as partners?

Nothing to report.

Have other collaborators or contacts been involved? No

Impacts

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

UNAVCO is the geodetic facility for NSF supporting scientific investigations that include the study of earthquake processes, mantle properties, active magmatic systems, plate boundary zone deformation, intraplate deformation and glacial isostatic adjustment, global geodesy and plate tectonics, atmospheric science, global change, and polar processes. A summary of several projects supported with the newly acquired TLS system is in the accomplishments section of this report, these projects illuminate the breadth of science disciplines that have been supported with the new instrument purchased with this award. In the first approximately six months of UNAVCO ownership, the new Riegl VZ1000 TLS system has supported projects in volcanology, glacial dynamics and climate change, biological sciences, sea-level rise and coastal processes, and

archeology. With technical capabilities such as full waveform data capture, we anticipate that the TLS system acquired in year one of this project will have considerable impact on the core Earth and Polar science disciplines as well as other NSF-supported disciplines such as ecology.

What is the impact on other disciplines?

As noted above, initial use of the new TLS system includes projects outside of UNAVCO's core disciplines, including biology and archeology. With technical capabilities such as full waveform data capture, we anticipate that the TLS system acquired in year one of this project will have considerable impact on other disciplines such as ecology.

What is the impact on the development of human resources?

As noted in the training section of this report, UNAVCO staff received specific training in the use of the new TLS system. This training is part of a larger effort to cross-train staff, and to develop core expertise in laser scanning technology and applications at UNAVCO.

UNAVCO also invests in a large and visible education and community engagement (ECE) program. An annual TLS introductory short course at the Geological Society of America meeting typically is filled to capacity, and provides important training to the UNAVCO community on TLS technology and its application to various Earth science applications. UNAVCO's program to bring TLS systems to undergraduate level geology field courses is growing annually. In 2014 alone, approximately 100 students were introduced to TLS technology, field data acquisition, and data processing and analysis at four field camps and one graduate neotectonics seminar field trip.

What is the impact on physical resources that form infrastructure?

The TLS systems acquired under this award will be important physical resources that form the backbone of UNAVCO's TLS EAR and PLR PI support program. These new systems bring additional technical capabilities and modernize UNAVCO's TLS instrument pool.

What is the impact on institutional resources that form infrastructure?

Nothing to report.

What is the impact on information resources that form infrastructure?

See Products section for new informational resources developed under this award.

What is the impact on technology transfer?

The UNAVCO facility and community are significant users of geodetic instrumentation such as GPS and Terrestrial Laser Scanning. Interactions with vendors ensure availability of equipment to meet scientific needs. Data collection and processing methods are disseminated via technical publications, conference presentations, and the UNAVCO website (www.unavco.org). All data acquired by the instrumentation is openly accessible via UNAVCO's data archive and can be leveraged by any federal, state, and local agency, and industry.

What is the impact on society beyond science and technology?

UNAVCO's Education and Community Engagement activities are focused upon providing resources and opportunities for education at multiple levels. UNAVCO has an active internship program called "RESESS," which is a paid undergraduate research internship, learning community, and mentoring program. RESESS students have received training in TLS data acquisition and processing methods, and used it in their summer research projects. One intern (M. Carnicle) used her knowledge of TLS in subsequent fieldwork in Italy. UNAVCO offers short course and other training courses to help graduate students and scientists learn more about geodesy, the applications of geodesy, and Earth Science. It also provides resources that use data and modern teaching techniques to use in teaching or after-school programs. The outreach activities by UNAVCO staff reach an audience beyond the scientific community. UNAVCO also reaches out to policy makers and decision makers to inform them of UNAVCO activities and UNAVCO-supported scientific discoveries.

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

A one-year no cost extension to this award was requested and granted. The primary cause of this NCE request was that preferred vendor for the second instrument purchase – Riegl - was unable to deliver the desired TLS system before the close of the award.

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.