

## Preview of Award 1242122 - 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:	1242122
Project Title:	CREST Phase II: Cyber-ShARE Center of Excellence
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Recipient Organization:	University of Texas at El Paso
Project/Grant Period:	09/01/2012 - 08/31/2017
Reporting Period:	09/01/2013 - 08/31/2014
Submitting Official (if other than PD\PI):	Ann Q Gates Principal Investigator
Submission Date:	06/03/2014
Signature of Submitting Official (signature shall be submitted in accordance with agency specific instructions)	Ann Q Gates

## Accomplishments

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

The **goals** of the center are as follows: (1) Conduct synergistic, interdisciplinary STEM research that uses and advances CI-enabled techniques and tools to support collaboration and sharing; (2) Train and educate a new generation of interdisciplinary, CI-knowledgeable professionals who represent the 21st century demographics; and (3) Extend the network of Cyber-ShARE collaborations to include other major cyberinfrastructure projects, international collaborators, and industry partners.

Specific **Center objectives** are associated with each goal. Goal 1 centers on synergistic interdisciplinary research and the objectives are: adopt and disseminate exemplary practices that deliberately support interdisciplinary research teams; serve as an institutional and national resource for effective semantic-enabled tools, resources, and practices; and support the integration of ideas across CREST-funded subprojects. Goal 2 focuses on training and education, and the objectives are as follows: expose middle and high school students in leveraged outreach programs to discovery-based applications that use CI; graduate students with the ability to apply CI approaches that support collaboration, work in interdisciplinary and cooperative teams, and apply cutting-edge techniques and tools for managing data; expand the number of students, especially those from underrepresented groups, who are involved in efforts associated with the Center; and deliver workshops to students, faculty, and professionals in areas that improve their proficiency in using CI and ability to work in interdisciplinary and collaborative teams. Goal 3 focuses on extending the network of collaborators and the objectives are

as follows: disseminate Cyber-ShARE technologies to El Paso's city and county governments and national organizations; and pursue relationships with national and international efforts that align with Cyber-ShARE technologies.

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

Major Activities: The objectives and activities associated with each Center goals are given below:

The **objectives for Goal 1** (conduct synergistic interdisciplinary research) are as follows:

- adopt and disseminate exemplary practices that deliberately support interdisciplinary research teams; and
- serve as an institutional and national resource for effective semantic-enabled tools, resources, and practices; and support the integration of ideas across CREST-funded subprojects.

**Goal 1 Activities:** Cyber-ShARE has been an integral contributor the university's efforts to promote and support interdisciplinary research at the university through its resources, i.e., human capital, education and training, and tools. The Center has been the anchor of a major project to establish a culture that supports sharing of practices and project results. Cyber-ShARE has played an integral part in the project and development of the cyberinfrastructure and communication-based model for building communities of practice around education and research areas of interest.

Another effort is development of the Meta-Share system that provides infrastructure to collect, generate, manage, and share data and knowledge. Meta-Share uses semantic technologies to extend data management plans. It provides a community-based user-driven system for recommendations and guidance, and it takes advantage of mapping scientific data lifecycle with development lifecycle. Cyber-ShARE has provided data management services to several projects at UTEP and expects to build on its services as the technologies mature. In addition, the Center is working with the Center for Institutional Evaluation, Research, and Planning to develop a long-term plan for information retrieval and integration centered on student success initiatives.

Other activities associated with Goal 1 are described under Specific Objectives.

The **objectives for Goal 2** (provide training and education) are as follows:

- expose middle and high school students in leveraged outreach programs to discovery-based applications that use CI;
- graduate students with the ability to apply CI approaches that support collaboration, work in interdisciplinary and cooperative teams, and apply cutting-edge techniques and tools for managing data;
- expand the number of students, especially those from underrepresented groups, who are involved in efforts associated with the Center; and
- deliver workshops to students, faculty, and professionals in areas that improve their proficiency in using CI and ability to work in interdisciplinary and collaborative teams.

**Goal 2 Activities.** The Center activities have focused on adding course content on CI technologies to existing courses, developing new courses, hosting a Distinguished Lecture series, contributing to the Computational Science program, and providing a Cyber-ShARE Showcase for a variety of outreach K-12 efforts.

A summary of the demographics of students involved with the Center is provided as an attachment. As shown in the figures, the number of students funded through Cyber-ShARE, disaggregated by race, ethnicity, and gender, reveals that the effectiveness of the Center in educating and involving a large number of students from

underrepresented groups.

Cyber-ShARE, with supplemental funding, is developing and delivering STEM modules that connect local and culturally relevant materials with the Mi Tierra-Mi Mundo interactive role play exploratory game of the Smithsonian Latino Center. The game is being customized to address sustainability issues associated with the Rio Grande watershed. It will scaffold Mi-Tierra-Mi Mundo and provide STEM modules.

Each student is required to take eight professional development workshops through UTEP, Cyber-Share, or professional conferences. This year, Cyber-Share provided Affinity Research Group professional development modules on “Documenting Your Data” (Spring 2014), “Delivering an Elevator Speech” (Spring 2013), and other student development of training modules on tools, e.g., GitLab code repository, documentation, video demo, and tutorials.

Cyber-ShARE has promoted STEAM (Science, Technology, Engineering, ART, Math) efforts through collaborations with UTEP’s Rubin Center for the Visual Arts and involvement with Francesca Samsel. Ms. Samsel created a visualization of Dr. Tweedie’s environmental research for Cyber-ShARE’s visualization wall called *Turbulence and Topography* that melds the data, graphs, photographs and drawings, to create a visual exploration for the viewer. The visualization is included in the Cyber-ShARE Showcase to tell the story of how researchers monitor, map and evaluate the ongoing physical changes in the arctic environment of Barrow, Alaska and the Chihuahuan Desert of New Mexico. In January 2014, Cyber-ShARE hosted a STEAM forum to share and advance STEAM initiatives. The speakers included Dr. Roger Malina, Distinguished Professor of Art and Technology at UT Dallas, who discussed the Texas Network for Arts, Science, and Technology; Dr. Suzanne Pierce, UT Austin, who described participatory deliberation; Francesca Samsel, Cyber-ShARE, who discussed her scientific visualization efforts with Los Alamos National Laboratory; and Melissa Carrillo, Smithsonian Latino Center.

Other activities of Ms. Samsel in this area include working with Los Alamos National Laboratory to develop new avenues for increasing perception and cognition within visualizations data, specifically as it relates to changes driven by exascale sampling methods. The goal is to develop budget-sensitive, perceptually-efficient visualization tools specifically designed for exascale data. Past work (not yet published) clearly demonstrates that it is possible to increase the user’s ability to digest a wider range of variable complexity through color. She has built color maps which enable scientists to perceive significantly greater detail within their data. With EnCompass Labs at UT Austin, she has been working on a Decision Support System for Water Policy with Dr. Suzanne Pierce.

The **objectives for Goal 3** (extend the network of collaborators) are as follows:

- disseminate Cyber-ShARE technologies to El Paso’s city and county governments and national organizations; and
- pursue relationships with national and international efforts that align with Cyber-ShARE technologies.

**Goal 3 Activities:** Cyber-ShARE has established two significant collaborations. First, the Center is a partner with the Center for the Advancement of Space Safety and Mission Assurance Research (CASSMAR), and it has established a strong collaboration (through a subcontract) with the new CREST Center Interdisciplinary Center of Research Excellence in Design of Intelligent Technologies for Smart Grids.

Other collaborative research includes subprojects centered on image processing, modeling of neuroscientific data within hypothalamic circuits, medical decision-making, and collaborative analytics through various data sources and reasoning.

Specific Objectives: The goal of the first subproject, **Knowledge Representation, Negotiation and Integration--Linking Human and Machine Knowledge Models through Semantics (iLink)**, is to facilitate interdisciplinary community engagement and ultimately knowledge negotiation and integration via semantic approaches.

**Towards iLink's first objective**, *investigate the ability of domain ontologies to represent mental models in IDR teams*, iLink members have worked on IDR teams' knowledge representation. An ontology to represent UTEP researchers' expertise is used in the Expertise Connector System to facilitate the creation and communication across IDR teams. The Jornada database and its corresponding ontology have been developed by iLink and iSense members with the goal of representing micrometeorological measurements to serve as baseline for the integration and exchange of data.

**iLink's second objective**, *facilitate knowledge negotiation in IDR teams through ontology alignment and visualization*, has been addressed with the development of methodologies for ontology alignment using PROV and the work towards the negotiation of common data through the ontologies extracted from databases using the DBOWLizer tool. The Virtual Learning Common is being designed and developed to support exchange of knowledge across disciplines and development of a shared vision. It is essentially a semantic-based social bookmarking tool that facilitates IDR teams as they marshal relevant resources from the web into a community area for sharing and discussion.

*Educate students with knowledge in Semantic Web and IDR teams and disseminate results*, **iLink's third objective**, has been addressed through iLink group's weekly meeting, development and participation in workshops, and involvement of students in research activities through internships and independent studies.

The goals of the second subproject, **Integrated Analysis for Development of 3-D Models of Earth Structure (iFuse)**, are to develop high-quality 3-D Earth models by using a highly integrated, multidisciplinary approach. The approach aims to: fuse different types of information from a variety of sources and with varying accuracy, sensitivity, and resolution; and consider geological and geophysical constraints and uncertainty levels.

**iFuse Objective 1** is *to expand the joint inversion optimization approach to include potential field and delay travel times*. The members of the iFuse subproject are developing and applying a multiple objective optimization joint inversion scheme for multiple geophysical datasets to construct 3-D shear wave models. In particular, it expands on a constrained optimization approach for joint inversion to characterize a one-dimensional Earth's structure.

**iFuse Objective 2** is *to refine model fusion for merging controlled and passive source experiments*. The iFuse members are establishing a theoretical framework for merging geophysical data sets. Traditionally, techniques for data fusion assume that the accuracies of different types of measurements are known. Based on these accuracies, the research investigates weights needed to combine different misfits between the model's prediction and observed data. The work seeks a model that minimizes the weighted misfit. In practice, these accuracies are not known. In such situations, it makes sense to produce the Pareto optimal family of models. The preliminary application to the joint inversion of several types of geophysical data shows that, for many combinations of weights, this results in reasonable models. Many of the resulting models show the same geophysical features, which confirms that these features are real.

**iFuse Objective 3** is *to explore the differences between the evolution of the East*

*African Rift System and that of the SRGR and ancient rift systems in Texas (includes expanding the data collection and analysis from the southern Rio Grande and collecting new controlled and passive source data in Kenya.* iFuse is using seismic data from regional networks in New Mexico, Texas, and the USArray, a dense network of permanent and portable seismographs placed systematically across the continental U.S. iFuse collects and processes seismic data with plans to expand to gravity data in the near future. The inversions estimate 1-D seismic S-wave velocity profiles to 300 km depth, which are then interpolated to a 3-D velocity model using a Bayesian kriging scheme. The models show a thin lower velocity crust anomaly along the southeastern Rio Grande Rift, a persistent low velocity anomaly underneath the Colorado Plateau and Basin and Range province, and another one at depth beneath the Jemez lineament, and the southern RGR. Models are also being developed in Texas.

The Geothermal Development Company (GDC) and UTEP have deployed fourteen seismic stations around the Menengai geothermal field and nine seismic stations in the vicinity of Silali volcano along the Kenya rift system to monitor the seismicity around the host volcano to help identify active faults and fracture systems that may contain hydrothermal fluids and favorable drilling targets. The subproject also has data from a controlled source experiment around Silali. The in-house data is being processed for quality control. In addition, iFuse is in the process of imaging the magma chambers of volcanoes. Cyber-ShARE expects to host GDC colleagues to work on the data at the Center.

**iFuse Objective 4** is to explore active geothermal systems using our complete analysis techniques and merging of magnetotelluric information. There is no progress on this objective to report.

The overarching goal of the third subproject, **Advancing Understanding of Ecosystem Processes Using Cyberinfrastructure (iSense)**, is to enhance understanding of ecosystem properties and processes by applying new CI-science approaches that identify factors affecting ecosystem structure and function in desert and arctic ecosystems over multiple spatiotemporal scales.

**iSense Objective 1** is to assess how multi-scale and multi-method approaches to environmental observation enhance understanding and extrapolation of ecosystem structural and functional properties and processes. The work at the Jornada Experimental Range explored the biophysical controls of ecosystem fluxes of carbon, water and energy of a shrubland ecosystem in the Northern Chihuahuan Desert. In another study, a student is surveying ~120km of arctic coast and documenting fine-scale Arctic coastal erosion trends. Another activity is In the area of Arctic, desert, and tropical phenological ecology, and it focuses on understanding the trends, triggers, and timing of seasonal plant growth and reproduction is an important field of study.

**iSense Objective 2** is to examine how uncertainty propagates from systematic error in cumulative flux estimates derived from data collected using eddy covariance towers measuring land-atmosphere carbon, water and energy exchange. In environmental science, researchers use an unusual heuristic model of measurement error, which is a combination of systematic, random, and periodic error components. While systematic and random error components are usual in error analysis, the use of periodic components and the resulting 3-component model are unusual. The research has provided a theoretical explanation for the model, and explained how it can be used to propagate uncertainty via computations. Another important part of the research is related to the fact that, according to experimental data, environment measurement errors are not normally distributed.

**iSense Objective 3** is to explore Semantic Web approaches for enhancing environmental data integration, discovery, access, and visualization in Web mapping applications. This work has resulted in a new data and information system developed for the more than 6 TB of data collected the Jornada Experimental Range. The system is being transitioned to integrate data and information from a large research site in northern Alaska.

Significant Results:

**Center:** The attached document presents data concerning the impact of the center on its involvement of students from underrepresented groups.

The Center's efforts in conjunction with leveraged funding from the I3 project has resulted in the Expertise Connector web portal that highlights scholarly and educational research at UTEP through researchers' profiles, research centers' profiles, "Move" communities, and research stories that are associated with researchers and centers. In addition, personnel from CyberShARE and the Office of Research and Sponsored Projects have been promoting and supporting interdisciplinary research initiatives on campus, including input into the Provost-led Interdisciplinary Research (IDR) Enhancement program that has funded four rounds of interdisciplinary research, the IDR Symposium (held spring 2013 and 2014), IDR Faculty Engagement Encounters and Connector events. Gates and Pennington have assisted in planning and development of the programs.

**iLink subproject:** The iLink group's research is being applied to four other projects associated with the Center. The NSF-funded Virtual Learning Commons (VLC) project (OCI-1135525) applies VisKo, which creates visualizations from scientific data, and CARP (Collect, Annotate, Refine, and Publish) for supporting researchers' sharing, identifying, and querying relevant collections of research resources available on the Web, and it applies its expertise in ontology development. The NASA-funded ELSEWeb project (ACCESS-11-0018) and a collaboration with Debra Peters, scientist in USDA ARS Jornada Experimental Range are leveraging iLink's expertise in semantic web services. The NSF-funded I3 project (DUE-0963648) applies its expertise in ontology development and data integration techniques in the Expertise Connector system.

A result of the iLink research is the DBOWLizer tool, which extracts ontologies from databases. This tool has been extended to support a wider range of database systems and provide a starting point for knowledge negotiation in IDR teams. In the VLC, the CARP methodology is deployed to generate ontologies that represent the "who, what, where, and when" of research activities. This is linked with faceted searching and visualization to support users' development of mental models about a field of active research that is relevant to their work, but may be occurring in a discipline outside of their own.

**iFuse subproject:** Understanding Earth's tectonic processes requires determining the Earth structure, and the research develops approaches to integrate multiple data sets to develop velocity models. By jointly inverting multiple geophysical data sets, it is possible to better handle the inherent non-uniqueness from inversion. To develop quasi 3-D models, the team interpolates the 1-D results using a kriging approach, only when we have excellent station coverage. The resultant quasi 3-D velocity models provide insight into the tectonic history and physical properties of the Earth structure.

One of the results of the research is the Multi-Objective Optimization (MOP) technique that enables the capability to combine linear and non-linear problems, homogeneous data sets, and different statistical properties of error associated with each data set. The research demonstrates through numerical and experimental

testing that the MOP scheme matches all data sets, is more robust, and is more flexible than traditional inversion approaches. With the ability to include receiver function, surface wave, body wave travel times in the inversions, the team now plans to expand to gravity in the next six months. Another result is a new micro-seismometer to measure wave-impact on permafrost coastlines that will be tested this summer. If successful, the instrument could become incorporated in the Arctic Observing Network

**iSense subproject:** The study at the Jornada Experimental Range found that the site acted as a weak sink for atmospheric carbon over the past four years, and the primary controls of land-atmosphere fluxes were soil temperature and plant available water, photosynthetic radiation, air temperature and indices of plant greenness. An empirical model to explain these fluxes also highlighted the importance of extreme events in this ecosystem. Novel use of cyberinfrastructure included the development of concept maps to describe multi-level data collection and processing using the eddy covariance method, testing the utility of different ground based systems used to monitor plant to landscape phenology, and several explorations of new methods useful for gap filling time series meteorological data. In addition, the iSense subproject has developed and tested, over the last several years, several new remote camera systems for capturing digital photographs of a range of ecosystems ranging from arctic tundra, and several different Chihuahuan Desert and Tropical forest landscapes. Over the past year, students have developed a custom, low power, wireless, high resolution and programmable camera to fit this need. They have also developed a software package that allows users to analyze thousands of repeat time-lapse photographs, including non-traditional color space which has been poorly investigated as a tool in the ecological sciences. Transfer of the prototype technology to Inupiat land managers in northern Alaska, Orangutan researchers in Borneo, and USDA and other researchers in the Desert Southwest.

Other results include a paper accepted to *Ecosphere* that discusses the challenge of harnessing the power of big data for ecology and environmental sciences. Most studies that have addressed this topic in the past have focused on data and metadata sharing, standardization, and accuracy. However, many scientists have not accepted the data deluge as an integral part of their research because the current scientific method is not scalable to large, complex datasets. The paper explains how integrating a data-intensive, machine learning approach with a hypothesis-driven, mechanistic approach can lead to a novel knowledge, learning, analysis system (KLAS) for discovery and problem solving.

Almost all large-scale research sites manage at least part of their data and information in a web mapping application (WMA). To date, however, WMAs have not been used for analyzing or visualizing data. The main roadblocks have included lack of data interoperability standards and webservices, lack of data provenance and other documentation, data size, server loading etc. Recent work is redeveloping existing WMAs for the sites on the Jornada Experimental Range and in the Arctic in HTML5 – JavaScript. A combination of this new technology, improved data management and harvesting from Dr. Laney's innovative data and information system, and the use of an indexer and several data visualization aids have dramatically improved capacities for enhancing the utility of WMAs for data mining, analysis, and visualization. Beta testing of applications is still ongoing and prototypes are expected to be released by the end of the year.

Key outcomes or  
Other achievements:

This section presents the results from the external evaluator, Dr. Heather Thiry.

### **Evaluation Methodology**

The project will include external evaluation and internal evaluation. The evaluation questions for the Cyber-ShARE project are:

**Q1.** To what extent, and in what ways, is the Center enabling synergistic, interdisciplinary research?

**Q2.** How well prepared are students as workforce-ready professionals?

**Q3.** How well developed is the network of Cyber-ShARE collaborations?

**Q4.** What is the value added by Cyber-ShARE?

**Q5.** What are the challenges faced by the Cyber-ShARE Center?

To answer these questions, a variety of data collection strategies will be used.

The external evaluation employs the following measures:

- **Faculty and student surveys** focused on the nature and extent of the interactions and relationships developed through the Cyber-ShARE Center. *Surveys were distributed in fall, 2013.*
- **Faculty, student, and organizational partner interviews** to explore the interdisciplinary interactions, communications, and learning facilitated by the Cyber-ShARE Center. Interviews also assess interdisciplinary research challenges and benefits to students and faculty. *Baseline interviews were conducted in the academic year 2012-13. Longitudinal interviews will be conducted in the academic year 2014-15.*

#### **Key evaluation findings**

**Q1.** To what extent, and in what ways, is the Center enabling synergistic, interdisciplinary research?

Research within the Cyber-ShARE Center spans a range of scientific, engineering and technical (SET) disciplines. Survey participants represented an array of fields: Computer Science, Geophysics, Business, Environmental Science, and Biological Sciences. Cyber-ShARE participants are disseminating their research findings in a range of disciplinary and interdisciplinary venues, and participating in conference presentation and publication at much higher rates than typical REU students (see Thiry & Hug, 2012).

- 85% of students attended a professional conference through Cyber-ShARE, **over 3x the rate of typical REU students**
- 54% of students presented a poster
- 23% of students presented a conference paper, **nearly twice the rate of typical REU students**

Survey results indicate that students contribute meaningfully to Cyber-ShARE projects and are included in the decision-making process.

- 75% of all respondents agreed that students contribute to decisions that impact the direction of the group.
- 95% of all respondents agreed that students understand their research goals and tasks.
- 75% of all respondents agreed that students receive the guidance they need to be successful. However, only 50% of undergraduate students agreed with that statement.

**Q2.** How well prepared are students as workforce-ready professionals?

Through supplemental training and workshops, as well as research experience on



Cyber-ShARE projects, students have gained a host of intellectual and communication skills that have prepared them for the workforce. While almost all students reported strong increases in skills, undergraduate students reported fewer gains in confidence than graduate students.

- 100% of all respondents marked that students gained knowledge *within* their own discipline, while 85% of respondents marked that students gained knowledge *outside* their discipline
- 95% of all respondents reported that students gained presentation skills
- 90% of all respondents marked that students understand the interdisciplinary research process
- 100% of graduate students had gained confidence that they could do well in their degree program as a result of their work in Cyber-ShARE, while 66% of undergraduate students reported the same gain in confidence.
- The majority of students (56%) report that their work in the Center has positively influenced their career goals.

**Q3.** How well developed is the network of Cyber-ShARE collaborations?

Cyber-ShARE participants developed strong, productive research collaborations and mentored newcomers. The majority of both graduate and undergraduate students (53%) reported that they have received formal or informal mentoring through their relationships in the Cyber-ShARE Center. There were differences, though, in graduate and undergraduate perceptions of mentoring. 83% of graduate students reported that they had a mentor that provided professional guidance and advice, while only 28% of undergraduates reported that they had a mentor that provided academic or professional guidance.

Overall, the vast majority of all respondents were satisfied with the organization of the Center and the collaborations that it enables. 90% of respondents categorized the Center as an organization in which individuals share ideas, resources, and information.

**Q4.** What is the value added by the Cyber-ShARE Center?

Because the Cyber-ShARE Center is more than the sum of its parts, it adds value to the university at large. Faculty members were asked to comment on the value added to the institution by housing the Cyber-ShARE Center. The main ways in which the Cyber-ShARE Center benefits the UTEP campus are:

- Providing interdisciplinary educational research experiences and training for students
- Increasing organizational capacity for interdisciplinary research on campus
- Raising the national profile of UTEP

**Q5.** What are the challenges faced by the Cyber-ShARE Center?

Faculty cited several challenges faced by the Cyber-ShARE Center. Chief among these is the financial future and sustainability of the Center. The primary challenges facing the Center in the next several years are:

- Financial sustainability, including securing diversified sources of funding
- Organizational planning for the future of the Center
- Academic evaluation system not oriented toward interdisciplinary publication

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

Cyber-ShARE conducts an annual orientation in which students work on team skills and participate in activities that focus on students understanding the alignment of their tasks with subproject and Cyber-ShARE goals. In addition to Affinity

Research Group and XSEDE workshops, students also gain access to professional development workshops through the SACNAS conference, as well as poster presentations that are given at the university and conferences.

A workshop on "Sharing Data across Disciplines" using the Affinity Resesarch Group model was developed and delivered by Cyber-ShARE post-docs. The workshop was attended by all Cyber-ShARE students as a forum to train students in Semantic Web technologies and collaborations in interdisciplinary teams. The application of methodologies and enhancement tools were developed in the iLink subproject.

Other opportunities for develop students' expertise to conduct research is through coursework, independent studies, and on-line studies. Dr. Villanueva Rosales has developed the "Cyberinfrastructure Applications" course that covers cyberinfrastructure foundations and semantic-driven data integration as an independent studies course. This course requires the development of a project that challenges students to a) propose innovative and strategic thinking to solve real-world problems, in particular those being tackled by the Knowledge Subproject that involve scientific data from the Center's projects, and b) encourage collaboration between students across disciplines. The students who have successfully taken this course, have joined the Center as research assistants due to the knowledge, skills and motivation provided by this course.

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

The results are disseminated through publications, conference presentations, and poster presentations as documented in the Products section. For example, the semantic research has been disseminated this past year in several cross-disciplinary settings. PI Villanueva Rosales Co-Chaired the AAAI Fall Symposium on Discovery Informatics in November, 2013 in Washington DC, where two peer-reviewed papers were presented by members of the iLink research group. Presentations were given by Co-PI Pennington at the Annual Meeting of the American Geophysical Union in December 2013, which has a very active Specialty Group on Cyberinfrastructure and at the Annual Meeting of the American Association of Geographers which had a special session on provenance. A new publication on semantic Web Services is currently in review and an accepted publication in Ecosphere describes the application of semantic based methods in ecology.

The Center received publicity through the El Paso Electric Company campaign that resulted in television ads and public service posters around the city: [http://www.poweronepe.com/index.html?utm\\_source=EIPaso-Electric&utm\\_medium=TopMenu-Icon&utm\\_campaign=Power-On](http://www.poweronepe.com/index.html?utm_source=EIPaso-Electric&utm_medium=TopMenu-Icon&utm_campaign=Power-On).

One of CyberShARE's undergraduate students, Josh Grajeda, will be featured in a public radio documentary about serving the "new majority" college student. We know UTEP has been working hard and successfully on this for decades. The one-hour documentary will air on public radio stations nationwide next fall and will feature first generation undergraduate students who are involved in undergraduate research.

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

With respect to Center Objective 1, the Center will continue to refine the MetaShARE tool, the Reporting System, and other collaboration tools. The Reporting System is being designed to generate reports automatically for the annual report and CREST Web report. The goal is to generalize its use for other projects and centers. MetaShare needs additional infrastructure to automate data collection and interact with iRods for data management policies. The Center will conduct rigorous V&V on products and pilot their use. We also plan to integrate WDO It into MetaShARE and the use of Visko in Virtual Learning Commons.

For Center Objective 2, the Center will begin working with Teacher Education researchers and the Smithsonian on a new grant. CyberShARE will continue work on a multi-touch screen that will be used to K-12 outreach and to develop outreach components that incorporate CyberShARE tools. We will also organize professional training, e.g., MetaShare tool and 3-D modeling using the visualization wall through XSEDE (TACC) when applicable.

For Center Objective 3, the Center will develop a strategic plan for regional engagement with the business and technical industries.

Members of the iLink subproject group will start investigating the ability of ontologies to represent mental models in IDR teams. The previous results of the Subproject's research will provide the building-blocks needed to facilitate knowledge

negotiation through ontology alignment and visualization. The focus of the research in the next reporting period will be investigating the role of ontology mappings techniques being developed in the group for knowledge negotiation. The group will also leverage the Visko framework, created at Cyber-ShARE, for the knowledge negotiation process. The iLink subproject group will continue educating students with knowledge in Semantic Web and the dissemination of previous results.

The next period, the 3-D modeling of iFuse group will be expanding its effort to collect new data in Colombia as we build new partnerships with Colombian institutes. We will continue to analyze data from field experiments in Kenya that focus on volcanic centers. This work is partially supported by the Geothermal Development Company. We expect GDC employees to visit the Center to finalize analysis of the newly collected data. The iFuse group is expanding the joint inversion approach to include 4 datasets, including receiver functions, surface waves, gravity, and body wave travel times. They expect to have new 3-D models in the continent U.S., using multiple data sets, as they expand the southern Rio Grande Rift work to the east throughout the state of Texas.

### Recommendations and Next Steps

While the Center has achieved many successes in interdisciplinary research efforts and recruiting and training diverse students, there are several future challenges.

- As the Cyber-ShARE Center nears the midway point of the renewal grant, project leadership should continue to plan for the long-term sustainability of the Center, including organizational and administrative structure and support, and securing funding from diverse sources.
- The Center should consider increasing its international collaborations and industry partnerships. These relationships raise the profile of the Center and may result in new and dynamic funding streams.
- The Center has successfully provided trainings and professional opportunities that have greatly benefited students. However, undergraduate students report less access to mentoring than graduate students. This may be due to the closer nature of the student-advisor relationship in graduate degree programs; nevertheless, the Center may consider ways to strengthen the intellectual and social integration of undergraduates into the Center.

### Supporting Files

Filename	Description	Uploaded By	Uploaded On
Cybershare Report 2014.pdf	External evaluator's full report.	Ann Gates	06/02/2014
studentData.pdf	Summary of student demographics and impact.	Ann Gates	06/02/2014

## Products

### Books

Kreinovich, Vladik (2013). *A review of "Contractions of Classical and Quantum Groups" by N. A. Gromov* Status = PUBLISHED; Acknowledgment of Federal Support = Yes ; Peer Reviewed = No

Kreinovich, Vladik (2014). *A review of "Methods to Solution of the Fuzzy Optimal Control Problems" by F. A. Aliev, A. A. Niftiyev, and J.I. Zeynalov* Status = PUBLISHED; Acknowledgment of Federal Support = Yes ; Peer Reviewed = No

Kreinovich, Vladik (2014). *Constraint Programming and Decision Making* Status = PUBLISHED; Acknowledgment of Federal Support = Yes ; Peer Reviewed = No

### Book Chapters

Kreinovich, Vladik (2013). In the Beginning Was the Word, and the Word was Fuzzy. *In the Beginning Was the Word, and the Word was Fuzzy* 337. Status = PUBLISHED; Acknowledgement of Federal Support = Yes ; Peer Reviewed = No

Kreinovich, Vladik (2013). Towards Optimizing Cloud Computing: An Example of Optimization under Uncertainty. *Towards Optimizing Cloud Computing: An Example of Optimization under Uncertainty* 613. Status = PUBLISHED;

Acknowledgement of Federal Support = Yes ; Peer Reviewed = No

Kreinovich, Vladik (2014). Adding Constraints -- A (Seemingly Counterintuitive but) Useful Heuristic in Solving Difficult Problems. *Adding Constraints -- A (Seemingly Counterintuitive but) Useful Heuristic in Solving Difficult Problems* 79. Status = PUBLISHED; Acknowledgement of Federal Support = Yes ; Peer Reviewed = No

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Kreinovich, Vladik (2014). Why Curvature in L-Curve: Combining Soft Constraints. *Why Curvature in L-Curve: Combining Soft Constraints* 175. Status = PUBLISHED; Acknowledgement of Federal Support = Yes ; Peer Reviewed = No

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Tweedie, Craig, Kreinovich, Vladik (2013). How to describe and propagate uncertainty when processing time series: metrological and computational challenges, with potential applications to environmental sciences. *How to describe and propagate uncertainty when processing time series: metrological and computational challenges, with potential applications to environmental sciences* 279. Status = PUBLISHED; Acknowledgement of Federal Support = Yes ; Peer Reviewed = No

Tweedie, Craig, Kreinovich, Vladik (2014). Selecting the Best Location for a Meteorological Tower: A Case Study of Multi-Objective Constraint Optimization. *Selecting the Best Location for a Meteorological Tower: A Case Study of Multi-Objective Constraint Optimization* 66. Status = PUBLISHED; Acknowledgement of Federal Support = Yes ; Peer

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### Conference Papers and Presentations

Kreinovich, Vladik (2014). *'And'- and 'Or'-Operations for 'Double', 'Triple', etc. Fuzzy Sets*. Proceedings of the IEEE World Congress on Computational Intelligence WCCI'2014. Beijing, China, July 6-11, 2014. Status = AWAITING\_PUBLICATION; Acknowledgement of Federal Support = Yes

Thompson, Lennox E, Velasco, Aaron A (2014). *3-D shear wave model development of the Texas region using an optimization scheme*. Seism. Res. Lett.. Status = PUBLISHED; Acknowledgement of Federal Support = Yes

Dove, A. K., Laney, C. M., Villanueva Rosales, N., Tweedie, C. (2013). *A Scalable Data Management System for Ecological Research*.. UTEP Campus Office of Undergraduate Research Initiatives (COURI) 2nd Annual Symposium.. El Paso, Texas. Status = OTHER; Acknowledgement of Federal Support = Yes

Kreinovich, Vladik (2013). *A Symmetry-Based Approach to Selecting Membership Functions and Its Relation to Chemical Kinetics*. Proceedings of the IEEE International Conference on Systems, Man, and Cybernetics IEEE SMC'2013. Manchester, UK, October 13-16, 2013. Status = PUBLISHED; Acknowledgement of Federal Support = Yes

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- Hicks, J. B., Villanueva Rosales, N. (2013). *Matching funding opportunities with potential applicants..* Campus Office of Undergraduate Research Initiatives (COURI) - The University of Texas at El Paso. El Paso, Texas. Status = UNDER\_REVIEW; Acknowledgement of Federal Support = Yes
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- Kreinovich, Vladik (2013). *Preface*. Springer Verlag. . Status = PUBLISHED; Acknowledgement of Federal Support = Yes
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Samsel, Francesca (2013). *Tableau Sponsored Event*. In conjunction with IEEE VIS 2012. Seattle, Washington. Status = OTHER; Acknowledgement of Federal Support = Yes

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Kreinovich, Vladik (2013). *Why Complex-Valued Fuzzy? Why Complex Values in General? A Computational Explanation*. Proceedings of the Joint World Congress of the International Fuzzy Systems Association and Annual Conference of the North American Fuzzy Information Processing Society IFSA/NAFIPS'2013. Edmonton, Canada, June 24-28, 2013. Status = PUBLISHED; Acknowledgement of Federal Support = Yes

Kreinovich, Vladik (2013). *Why Inverse F-transform? A Compression-Based Explanation*. Proceedings of the 2013 International Conference on Fuzzy Systems FUZZ-IEEE'2013. Hyderabad, India, July 7-10, 2013. Status = PUBLISHED; Acknowledgement of Federal Support = Yes

Kreinovich, Vladik (2014). *Wiener's Conjecture About Transformation Groups Helps Predict Which Fuzzy Techniques Work Better*. Proceedings of the 2014 Annual Conference of the North American Fuzzy Information Processing Society NAFIPS'2014. Boston, Massachusetts, June 24-26, 2014. Status = PUBLISHED; Acknowledgement of Federal Support =

Yes

## Inventions

### Journals

Del Rio, Nicholas R., Pennington, Deana, Villanueva Rosales, Natalia (2014). Leveraging linked open data to bridge data-to-biodiversity model interactions. *International Journal of Earth Science Informatics*. . Status = UNDER\_REVIEW; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes

Del Rio, Nicholas R., Villanueva Rosales, Natalia (2014). The SemanticScience Integrated Ontology (SIO) for Biomedical Research and Knowledge Discovery. *The Journal of Biomedical Semantics*. 5,2014 . Status = PUBLISHED; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes

Gandara, Aida, and Villanueva Rosales, Natalia (2013). Documenting and Sharing Scientific Research over the Semantic Web. *International Conference on Knowledge Management and Knowledge Technologies*. NA TBD. Status = PUBLISHED; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes

Kreinovich, Vladik 17, 2013 Tuesday, January 1, 2013 1319-1327 (2013). Interval or Moments: Which Carry More Information?. *Soft Computing*. 17,2013 1319. Status = PUBLISHED; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes

Kreinovich, Vladik (2013). A New Analog Optical Processing Scheme for Solving NP-Hard Problems. *Journal of Uncertain Systems*. 7, 2013 238. Status = PUBLISHED; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes

Kreinovich, Vladik (2013). Brans-Dicke Scalar-Tensor Theory of Gravitation May Explain Time Asymmetry of Physical Processes. *Mathematical Structures and Modeling*. 27,2013 28. Status = PUBLISHED; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes

Kreinovich, Vladik (2013). Checking Monotonicity Is NP-Hard Even for Cubic Polynomials. *Reliable Computing*. 18,2013 90. Status = PUBLISHED; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes

Kreinovich, Vladik (2013). Estimating Correlation under Interval Uncertainty. *Mechanical Systems and Signal Processing*. 37,2013 43. Status = PUBLISHED; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes

Kreinovich, Vladik (2013). For Describing Uncertainty, Ellipsoids Are Better than Generic Polyhedra and Probably Better than Boxes: A Remark. *Mathematical Structures and Modeling*. 27,2013 38. Status = PUBLISHED; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes

Kreinovich, Vladik (2013). How to Define Relative Approximation Error of an Interval Estimate: A Proposal. *Applied Mathematical Sciences*. 7,2013 211. Status = PUBLISHED; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes

Kreinovich, Vladik (2013). Imprecise probabilities in engineering analyses. *Mechanical Systems and Signal Processing*. 37 4-29. Status = PUBLISHED; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes

Kreinovich, Vladik (2013). Imprecise probabilities in engineering analyses. *Mechanical Systems and Signal Processing*. 4. Status = AWAITING\_PUBLICATION; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes

Kreinovich, Vladik (2013). In quantum physics, free will leads to nonconservation of energy. *Journal of Uncertain Systems*. 7, 2013 176. Status = PUBLISHED; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes

Kreinovich, Vladik (2013). Is It Possible to Have a Feasible Enclosure-Computing Method Which Is Independent of the Equivalent Form?. *Reliable Computing*. 18,2013 1. Status = PUBLISHED; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes

Kreinovich, Vladik (2013). Orders on Intervals Over Partially Ordered Sets: Extending Allen's Algebra and Interval Graph Results. *Soft Computing*. 17,2013 1379. Status = PUBLISHED; Acknowledgment of Federal Support = Yes ; Peer

Reviewed = Yes

Kreinovich, Vladik (2013). Towards Fast and Accurate Algorithms for Processing Fuzzy Data: Interval Computations Revisited. *International Journal of General Systems*. 42,2013 197. Status = PUBLISHED; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes

Kreinovich, Vladik (2013). Using Symmetries (Beyond Geometric Symmetries) in Chemical Computations: Computing Parameters of Multiple Binding Sites. *Symmetry*. 90. Status = UNDER\_REVIEW; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes

Kreinovich, Vladik (2014). Deep mathematical results are the ones that connect seemingly unrelated areas: towards a formal proof of Gian-Carlo Rota's thesis. *Applied Mathematical Sciences*. 2391. Status = AWAITING\_PUBLICATION; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes

Kreinovich, Vladik (2014). Dialect or a New Language: A Possible Explanation of the 70% Mutual Intelligibility Threshold. *International Mathematical Forum*. 189. Status = AWAITING\_PUBLICATION; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes

Kreinovich, Vladik (2014). Filtering out high frequencies in time series using F-transform. *Information Sciences*. . Status = AWAITING\_PUBLICATION; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes

Kreinovich, Vladik (2014). For each mathematical statement, only finitely many of its generalizations are useful: a formal proof of E. Bishop's idea. *International Mathematical Forum*. 763. Status = AWAITING\_PUBLICATION; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes

Kreinovich, Vladik (2014). How to Faster Test a Device for Different Combinations of Parameters. *Journal of Uncertain Systems*. 8, 2014 . Status = PUBLISHED; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes

Kreinovich, Vladik (2014). How to Fully Represent Expert Information about Imprecise Properties in a Computer System -- Random Sets, Fuzzy Sets, and Beyond: An Overview. *International Journal of General Systems*. . Status = AWAITING\_PUBLICATION; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes

Kreinovich, Vladik (2014). Images are Easier to Restore than 1-D Signals: A Theoretical Explanation of a Surprising Empirical Phenomenon. *Journal of Uncertain Systems*. 8, 2014 . Status = PUBLISHED; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes

Kreinovich, Vladik (2014). Simpler-to-Describe Cases are Often More Difficult to Prove: A Possible Explanation. *International Mathematical Forum*. 767. Status = AWAITING\_PUBLICATION; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes

Kreinovich, Vladik (2014). Square Root of  $x^2 + \text{const}$  is the Most Computationally Efficient Smooth Approximation to  $|x|$ : a Proof. *Journal of Uncertain Systems*. 8, 2014. Status = PUBLISHED; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes

Kreinovich, Vladik (2014). Why A Model Produced by Training a Neural Network Is Often More Computationally Efficient than a Nonlinear Regression Model: A Theoretical Explanation. *Journal of Uncertain Systems*. 8, 2014 . Status = PUBLISHED; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes

Kreinovich, Vladik (2014). Zipf's Law and 7+-2 Principle Lead to a Possible Explanation of Daniel's Law. *International Mathematical Forum*. 9, 2014 391. Status = PUBLISHED; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes

Kreinovich, Vladik, Argaez, Miguel (2013). Why I1 Is a Good Approximation to I0: A Geometric Explanation. *Journal of Uncertain Systems*. 7,2013 203. Status = PUBLISHED; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes

Pennington, Deana, Kreinovich, Vladik (2014). On Early Stages of Idea Propagation, the Number of Adopters Grows as  $n(t) \sim c * t^a$ : Theoretical Explanation of the Empirical Observation. *Journal of Uncertain Systems*. 8, 2014 . Status =

PUBLISHED; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes

Tweedie, Craig, Villanueva Rosales, Natalia (2014). Harnessing the power of big data: infusing the scientific method with machine learning to transform ecology. *Ecosphere*. . Status = AWAITING\_PUBLICATION; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes

Tweedie, Craig, Villanueva Rosales, Natalia (2014). Harnessing the power of big data: infusing the scientific method with machine learning to transform ecology. *Ecosphere*. . Status = AWAITING\_PUBLICATION; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes

## Licenses

## Other Products

### Other Publications

Thompson, Lennox E, Velasco, Aaron A. (2014). *3-D Structure of the Southern Rio Grande Rift from 1-D Constrained Joint Inversion of Receiver Functions and Surface Wave Dispersion*. Cyber-ShARE participant(s) funded by CREST program. Status = UNDER\_REVIEW; Acknowledgement of Federal Support = Yes

Thompson, Lennox E, Velasco, Aaron A (2014). *3-D Structure of the Southern Rio Grande Rift from 1-D Constrained Joint Inversion of Receiver Functions and Surface Wave Dispersion*. Cyber-ShARE participant(s) funded by CREST Program.. Status = UNDER\_REVIEW; Acknowledgement of Federal Support = Yes

Gates, Ann Q (2013). *A Forum on MOOCs: An Opportunity for HSIs?--A Practitioner's Perspective*. SACNAS 2013 San Antonio, Texas Tuesday, October 1, 2013. Status = OTHER; Acknowledgement of Federal Support = Yes

Villanueva Rosales, Natalia (2013). *A Virtual Geocaching Backend: Data Integration with a Content Management Framework*.. 2013 SACNAS National Conference San Antonio, TX Saturday, October 5, 2013. Status = OTHER; Acknowledgement of Federal Support = Yes

Villanueva Rosales, Natalia, Pennington, Deana (2014). *A graphical interface for ELSEWeb*. MS Project presentation - Lillian Torres Cyber-ShARE at UTEP Wednesday, February 26, 2014. Status = OTHER; Acknowledgement of Federal Support = Yes

Kreinovich, Vladik (2014). *A review of "A set arithmetic-based linear regression model for modeling interval-valued responses through real-valued variables" by A. Blanco-Fernandez, A. Clubi, and M. Garcia-Barzana*. Cyber-ShARE participant(s) funded by CREST Program. Status = PUBLISHED; Acknowledgement of Federal Support = Yes

Kreinovich, Vladik (2014). *A review of "A set arithmetic-based linear regression model for modelling interval-valued responses through real-valued variables" by A. Blanco-Fernandez, A. Colubi, and M. Garcia-Barzana*. Cyber-ShARE participant(s) funded by CREST Program.. Status = PUBLISHED; Acknowledgement of Federal Support = Yes

Kreinovich, Vladik (2014). *A review of "On constructing fuzzy classifiers from interval-valued data in case of unstable clustering structure" by D.A. Viattchenin*. Cyber-ShARE participant(s) funded by CREST Program. Status = PUBLISHED; Acknowledgement of Federal Support = Yes

Kreinovich, Vladik (2014). *A review of "On constructing fuzzy classifiers from interval-valued data in case of unstable clustering structure" by D. A. Viattchenin*. Cyber-ShARE participant(s) funded by CREST. Status = PUBLISHED; Acknowledgement of Federal Support = Yes

Kreinovich, Vladik (2014). *A review of "Optimal uncertainty quantification" by H. Ohwadi, C. Scovel, T. J. Sullivan, M. McKerns, and M. Ortiz*. Cyber-ShARE participant(s) funded by CREST Program.. Status = PUBLISHED; Acknowledgement of Federal Support = Yes

Kreinovich, Vladik (2014). *A review of "Optimal uncertainty quantification" by H. Ohwadi, C. Scovel, T. J. Sullivan, M. McKerns, and M. Ortiz*. Cyber-ShARE participant(s) funded by CREST Program.. Status = PUBLISHED; Acknowledgement of Federal Support = Yes

- Kreinovich, Vladik (2014). *A review of The interval intersection method for FE model updating* by S. Gabriele and "Model updating of Pescara benchmark: interval vs. traditional method" by S. Gabriele, F. Brancaleoni, and D. Spina. Cyber-ShARE participan(s) funded by CREST Program. Status = PUBLISHED; Acknowledgement of Federal Support = Yes
- Kreinovich, Vladik (2014). *A review of The interval intersection method for FE model updating* by S. Gabriele and "Model updating of Pescara benchmark: interval vs. traditional method" by S. Gabriele, F. Brancaleoni, and D. Spina. Cyber-ShARE participant(s) funded by CREST Program.. Status = PUBLISHED; Acknowledgement of Federal Support = Yes
- Gandara, Aida (2014). *Career Day: Doctoral Computer Scientist*. Jose Damian Elementary Career Day El Paso, Texas Wednesday, May 21, 2014. Status = OTHER; Acknowledgement of Federal Support = Yes
- Tweedie, Craig (2013). *Causes & Consequences of Increased Dissolved Organic Carbon in Arctic tundra ponds over the past 40 years..* American Geophysical Union Fall Meeting San Francisco, CA Sunday, December 1, 2013. Status = OTHER; Acknowledgement of Federal Support = Yes
- Velasco, Aaron A (2013). *Collaborative Investigation of Remotely Triggered Tremor and Earthquakes in Latin America*. Fall Meeting of the American Geophysical Union San Francisco, CA Sunday, December 1, 2013. Status = OTHER; Acknowledgement of Federal Support = Yes
- Velasco, Aaron A (2013). *Crustal and Upper Mantle Structure from Surface Wave Dispersion in Northern Libya and the East-Central Mediterranean*. Fall Meeting of the American Geophysical Union San Francisco, CA Sunday, December 1, 2013. Status = OTHER; Acknowledgement of Federal Support = Yes
- Velasco, Aaron A (2013). *Developing a 3-D Shear Wave Model Using a Multi-Objective Joint Inversion scheme*. International Conference on Applied Mathematics and Informatics San Andreas Island, Colombia Friday, November 1, 2013. Status = OTHER; Acknowledgement of Federal Support = Yes
- Velasco, Aaron A (2013). *Dynamic triggering potential of large earthquakes recorded by the EarthScope U.S. Transportable Array using a frequency domain detection method*. Fall Meeting of the American Geophysical Union San Francisco, CA Sunday, December 1, 2013. Status = OTHER; Acknowledgement of Federal Support = Yes
- Velasco, Aaron A (2013). *Evidence of Active and Failed Rifts in the Southwest United States Using Joint Inversion of Geophysical Data*. Fall Meeting of the American Geophysical Union San Francisco, CA Sunday, December 1, 2013. Status = OTHER; Acknowledgement of Federal Support = Yes
- Tweedie, Craig (2013). *Formation of pedogenic carbonates in the semi-arid Rio Grande valley: insights from carbon, major elements, and U-series isotopes in natural and agricultural soils of southern New Mexico and western Texas*. American Geophysical Union Fall Meeting San Francisco, CA Thursday, December 12, 2013. Status = OTHER; Acknowledgement of Federal Support = Yes
- Villanueva Rosales, Natalia (2013). *Investigating the Role of Provenance in Ontology Mapping..* SACNAS National Conference San Antonio, TX Thursday, October 3, 2013. Status = OTHER; Acknowledgement of Federal Support = Yes
- Villanueva Rosales, Natalia, Pennington, Deana (2013). *L1. Data Science: Telling the Stories Behind the Data..* 2013 SACNAS Conference San Antonio, TX Friday, October 4, 2013. Status = OTHER; Acknowledgement of Federal Support = Yes
- Velasco, Aaron A (2013). *Microseismic and Ambient Noise Cross-Correlation Study of Menengai Caldera: Geothermal Prospect in the Central Kenya Dome*. International Conference on Applied Mathematics and Informatics San Andreas Island, Colombia Friday, November 1, 2013. Status = OTHER; Acknowledgement of Federal Support = Yes
- Kreinovich, Vladik (2014). *Modeling Dependence in Econometrics*. Cyber-ShARE participant(s) funded by CREST Program.. Status = PUBLISHED; Acknowledgement of Federal Support = Yes
- Kreinovich, Vladik (2014). *Modeling Dependence in Econometrics*. Cyber-ShARE participant(s) funded by CREST Program.. Status = PUBLISHED; Acknowledgement of Federal Support = Yes

Velasco, Aaron A (2013). *On the Optimization of the Inverse Problem for Bouguer Gravity Anomalies*. Fall Meeting of the American Geophysical Union San Francisco, CA Sunday, December 1, 2013. Status = OTHER; Acknowledgement of Federal Support = Yes

Gates, Ann Q (2013). *Submitting a Successful Fellowship Application*. Graduate Student Workshop, UTEP Sunday, September 1, 2013. Status = OTHER; Acknowledgement of Federal Support = Yes

Velasco, Aaron A (2013). *Unique seismic controlled sources: Using the demolition of smelter tower stacks and the City Hall in El Paso, TX for a seismic survey*. Fall Meeting of the American Geophysical Union San Francisco, CA Sunday, December 1, 2013. Status = OTHER; Acknowledgement of Federal Support = Yes

Villanueva Rosales, Natalia (2013). *iLink Group research*. CS Open House Computer Science Department, UTEP Friday, September 6, 2013. Status = OTHER; Acknowledgement of Federal Support = Yes

## Patents

### Technologies or Techniques

MetaShare: Data Management System

Data Reporting System: Project data collection system

Workflow-driven Ontology: approach for defining scientific workflows annotated with provenance and based on ontologies

DBOWLizer tool: Extract ontologies from databases

Visko: Framework that supports the answering of visualization queries for generating visualizations by specifying what visualization is needed rather than how to build the visualization.

Model Fusion: Combining different Earth models using joint inversion techniques, in particular accuracy-estimating techniques that lead to geophysically reasonable estimates and more accurate model fusion results.

CARP Methodology: Methodology for sharing documentation about scientific research over the Semantic Web.

Multiple Objective Optimization technique: enables the capability to combine linear and non-linear problems, homogeneous data sets, and different statistical properties of error associated with each dataset.

Low-power, wireless, high resolution programmable camera to capture digital programs in the arctic tundra, Chihuahuan Desert and tropical forest landscape.

MetaShare

Data Reporting System

Joint Inversion

Model Fusion

WDO Framework

Visko

As part of our research effort, we have developed new accuracy-estimating techniques, techniques which lead to geophysically reasonable estimates and thus, to more accurate model fusion results.

**CARP Methodology**: CARP, which stands for the Collect-Annotate-Refine-Publish Methodology, is a methodology for sharing documentation about scientific research over the Semantic Web. CARP describes scientific research results as a scientific collection of Web resources such that the Web resources are semantically described using existing Web content,



relationships between Web resources are explicitly identified and the collection is searchable over the Semantic Web Methodology

## Thesis/Dissertations

### Websites

*Cyber-ShARE Center*

<http://cybershare.utep.edu>

Main website of the Cyber-ShARE Center

*Expertise Connector*

<http://expertise.utep.edu>

The Expertise System has the following features:

**Faculty and Professional Staff Profiles:** To assist in keeping profiles current, profile information will be managed through Digital Measures: picture, title, contact information, CV, personal expertise statement, personal Website, social network memberships, associated UTEP's research priority areas, and keywords.

**Center Profiles:** Overview of Centers, including mission and goals, capabilities, Website, and contact information.

**Research Stories:** The published stories coming from Communications will be linked to faculty and professional staff, centers, departments, colleges, university units, and research priority areas.

**I3 Move communities:** Groups of people who share a common purpose around a topic.

## Participants/Organizations

### What individuals have worked on the project?

Name	Most Senior Project Role	Nearest Person Month Worked
Gates, Ann	PD/PI	3
Pennington, Deana	Co PD/PI	12
Tweedie, Craig	Co PD/PI	3
Velasco, Aaron	Co PD/PI	3
Villanueva Rosales, Natalia	Co PD/PI	3
Kreinovich, Vladik	Co-Investigator	3
Hussein, Musa	Postdoctoral (scholar, fellow or other postdoctoral position)	0
Salayandia, Leonardo	Postdoctoral (scholar, fellow or other postdoctoral position)	0
Sosa Aguirre, Uram	Postdoctoral (scholar, fellow or other postdoctoral position)	0

<b>Name</b>	<b>Most Senior Project Role</b>	<b>Nearest Person Month Worked</b>
Esparza, Patricia	Other Professional	9
Fierro, Candice	Other Professional	0
Gris, Ivan	Other Professional	0
Kassin, Ari	Other Professional	5
Osuna, Francisco	Other Professional	9
Roy, Mary	Other Professional	1
Romero, Rodrigo	Staff Scientist (doctoral level)	0
Aguirre, Diego	Graduate Student (research assistant)	5
Arellano, Brenda	Graduate Student (research assistant)	5
Arora, Jitin	Graduate Student (research assistant)	0
Avila, Carmen	Graduate Student (research assistant)	0
Celis, Sergio	Graduate Student (research assistant)	5
Chacon, Cesar	Graduate Student (research assistant)	0
Cody, Ryan	Graduate Student (research assistant)	2
Contreras, Mayra	Graduate Student (research assistant)	5
Copenhaver, Walter	Graduate Student (research assistant)	3
Del Rio, Nicholas	Graduate Student (research assistant)	6
Dove, Alla	Graduate Student (research assistant)	0
Flores, Guillermo	Graduate Student (research assistant)	0
Gandara, Aida	Graduate Student (research assistant)	6
Garcia, Ariel	Graduate Student (research assistant)	2
Garcia Contreras, Angel	Graduate Student (research assistant)	0
Garza, Javier	Graduate Student (research assistant)	5

<b>Name</b>	<b>Most Senior Project Role</b>	<b>Nearest Person Month Worked</b>
Garza, Antonio	Graduate Student (research assistant)	0
Giandoni, Matthew	Graduate Student (research assistant)	2
Hari, Madhulatha	Graduate Student (research assistant)	0
Jaimes, Aline	Graduate Student (research assistant)	2
Kim, Young-An	Graduate Student (research assistant)	0
Laney, Christine	Graduate Student (research assistant)	6
Lerma, Leonardo	Graduate Student (research assistant)	5
Lopez, Abdiel	Graduate Student (research assistant)	2
Munipala, Umayanganie	Graduate Student (research assistant)	3
Nevarez, Jesus	Graduate Student (research assistant)	0
Nieto, Elba	Graduate Student (research assistant)	2
Ochoa, Omar	Graduate Student (research assistant)	5
Olaya, Julio	Graduate Student (research assistant)	5
Ollivier, Erika	Graduate Student (research assistant)	0
Owen, Geoffrey	Graduate Student (research assistant)	2
Padilla, Edgar	Graduate Student (research assistant)	2
Patlan, Ezer	Graduate Student (research assistant)	5
Porras, Hugo	Graduate Student (research assistant)	0
Ramirez Garcia, Geovany	Graduate Student (research assistant)	2
Rivera, Norma	Graduate Student (research assistant)	5
Saenz, Hector	Graduate Student (research assistant)	0
Servin, Christian	Graduate Student (research assistant)	2
Tai, Waiyan	Graduate Student (research assistant)	5

<b>Name</b>	<b>Most Senior Project Role</b>	<b>Nearest Person Month Worked</b>
Thompson, Lennox	Graduate Student (research assistant)	2
Udakandage, Lakshika	Graduate Student (research assistant)	4
Vargas, Sergio	Graduate Student (research assistant)	2
Villarreal, Sandra	Graduate Student (research assistant)	2
Zamora, Azucena	Graduate Student (research assistant)	6
Aguirre, Joseph	Undergraduate Student	2
Aldaz-Cervantes, Mayela	Undergraduate Student	4
Barraza, Maria	Undergraduate Student	2
Berumen, Jorge	Undergraduate Student	0
Betancourt Marrufo, Edith	Undergraduate Student	0
Franco Gutierrez, Diana	Undergraduate Student	0
Grajeda, Joshua	Undergraduate Student	5
Grijalva, Ashley	Undergraduate Student	0
Hicks, Joshua	Undergraduate Student	5
Higareda, Gabriel	Undergraduate Student	4
Jackson, Nicholas	Undergraduate Student	1
Keck, Jennifer	Undergraduate Student	1
KoFoed, Keith	Undergraduate Student	2
Lopez, Elizabeth	Undergraduate Student	0
Lopez, Julian	Undergraduate Student	0
Lujan, Karla	Undergraduate Student	2
Luna, Naomi	Undergraduate Student	2
Melendez, Mayra	Undergraduate Student	0

Name	Most Senior Project Role	Nearest Person Month Worked
Munoz, Roberto	Undergraduate Student	2
Nieto, Carlos	Undergraduate Student	0
Ochoa, Loren	Undergraduate Student	0
Pena, Marianna	Undergraduate Student	0
Pennington, Travis	Undergraduate Student	1
Remirez, Oscar	Undergraduate Student	5
Reyna, Joaquin	Undergraduate Student	3
Rister, Matthew	Undergraduate Student	1
Rodriguez, Juan	Undergraduate Student	0
Tabares, Jesus	Undergraduate Student	5
Teran Lopez, Christian	Undergraduate Student	2
Torres, Lillian	Undergraduate Student	2
Valtierra, Karina	Undergraduate Student	5
Villegas, Bertha	Undergraduate Student	2
Villegas, Ana	Undergraduate Student	5
Samsel, Francesca	Consultant	1

#### Full details of individuals who have worked on the project:

**Ann Q Gates**

**Email:** agates@utep.edu

**Most Senior Project Role:** PD/PI

**Nearest Person Month Worked:** 3

**Contribution to the Project:** PI, Director

**Funding Support:** NSF HRD-1242122

**International Collaboration:** No

**International Travel:** No

**Deana Pennington****Email:** ddpennington@utep.edu**Most Senior Project Role:** Co PD/PI**Nearest Person Month Worked:** 12**Contribution to the Project:** co-Director; co-lead of subproject**Funding Support:** NSF HRD-1242122**International Collaboration:** No**International Travel:** No**Craig E Tweedie****Email:** ctweedie@utep.edu**Most Senior Project Role:** Co PD/PI**Nearest Person Month Worked:** 3**Contribution to the Project:** Lead subproject**Funding Support:** NSF HRD-1242122**International Collaboration:** No**International Travel:** No**Aaron Velasco****Email:** velasco@geo.utep.edu**Most Senior Project Role:** Co PD/PI**Nearest Person Month Worked:** 3**Contribution to the Project:** Subproject lead**Funding Support:** NSF HRD-1242122**International Collaboration:** Yes, Kenya**International Travel:** Yes, Kenya - 0 years, 0 months, 14 days; Colombia - 0 years, 0 months, 5 days**Natalia Villanueva Rosales****Email:** nvillanuevarosales@utep.edu**Most Senior Project Role:** Co PD/PI**Nearest Person Month Worked:** 3**Contribution to the Project:** Subproject co-lead**Funding Support:** NSF HRD-1242122**International Collaboration:** No**International Travel:** Yes, Mexico - 0 years, 1 months, 0 days; Canada - 0 years, 1 months, 0 days**Vladik Kreinovich****Email:** vladik@utep.edu**Most Senior Project Role:** Co-Investigator**Nearest Person Month Worked:** 3

**Contribution to the Project:** Contributes to iSense and iFuse subprojects.

**Funding Support:** NSF HRD-1242122

**International Collaboration:** Yes, Colombia

**International Travel:** Yes, Colombia - 0 years, 0 months, 5 days; United Kingdom - 0 years, 0 months, 5 days; Czech Republic - 0 years, 0 months, 5 days; Russian Federation - 0 years, 0 months, 5 days

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**Musa J Hussein**

**Email:** mjhussein@miners.utep.edu

**Most Senior Project Role:** Postdoctoral (scholar, fellow or other postdoctoral position)

**Nearest Person Month Worked:** 0

**Contribution to the Project:** Post Doctoral contributed to Cyber-ShARE under the GEO subproject.

**Funding Support:** Funded by Cyber-ShARE award

**International Collaboration:** No

**International Travel:** No

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**Leonardo Salayandia**

**Email:** leonardo@utep.edu

**Most Senior Project Role:** Postdoctoral (scholar, fellow or other postdoctoral position)

**Nearest Person Month Worked:** 0

**Contribution to the Project:** Leonardo Salayandia is functioning as Post-Doctoral participant at Cyber-ShARE.

**Funding Support:** Funded by Cyber-ShARE award

**International Collaboration:** No

**International Travel:** No

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**Uram A Sosa Aguirre**

**Email:** usosaaguirre@miners.utep.edu

**Most Senior Project Role:** Postdoctoral (scholar, fellow or other postdoctoral position)

**Nearest Person Month Worked:** 0

**Contribution to the Project:** Graduate Research Assistant contributed to Cyber-ShARE under the GEO subproject

**Funding Support:** Funded by Cyber-ShARE award

**International Collaboration:** No

**International Travel:** No

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**Patricia Esparza**

**Email:** pesparza3@utep.edu

**Most Senior Project Role:** Other Professional

**Nearest Person Month Worked:** 9

**Contribution to the Project:** Patricia Esparza is the program coordinator at Cyber-ShARE.

**Funding Support:** Funded by Cyber-ShARE award and I3 award.

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**International Collaboration:** No

**International Travel:** No

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**Candice Christine Fierro**

**Email:** ccfierro@utep.edu

**Most Senior Project Role:** Other Professional

**Nearest Person Month Worked:** 0

**Contribution to the Project:** Candice is the Research Technician at Cyber-ShARE.

**Funding Support:** Funded by Cyber-ShARE award

**International Collaboration:** No

**International Travel:** No

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**Ivan Gris**

**Email:** igris@utep.edu

**Most Senior Project Role:** Other Professional

**Nearest Person Month Worked:** 0

**Contribution to the Project:** Ivan Gris was collaborating at Cyber-ShARE as Research Associate

**Funding Support:** Funded by Cyber-ShARE award

**International Collaboration:** No

**International Travel:** No

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**Ari Kassin**

**Email:** akassin@utep.edu

**Most Senior Project Role:** Other Professional

**Nearest Person Month Worked:** 5

**Contribution to the Project:** Ari Kassin is collaborating at Cyber-ShARE as Research Assistant

**Funding Support:** Funded by Cyber-ShARE award

**International Collaboration:** No

**International Travel:** No

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**Francisco Osuna**

**Email:** fjosuna@utep.edu

**Most Senior Project Role:** Other Professional

**Nearest Person Month Worked:** 9

**Contribution to the Project:** Francisco Osuna is the Research Specialist at Cyber-ShARE.

**Funding Support:** Funded by Cyber-ShARE award

**International Collaboration:** No

**International Travel:** No

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**Mary K. Roy****Email:** mkroy@utep.edu**Most Senior Project Role:** Other Professional**Nearest Person Month Worked:** 1**Contribution to the Project:** Mary K. Roy is the Program Manager at Cyber-ShARE.**Funding Support:** Funded by Cyber-ShARE award**International Collaboration:** No**International Travel:** No**Rodrigo A Romero****Email:** raromero2@utep.edu**Most Senior Project Role:** Staff Scientist (doctoral level)**Nearest Person Month Worked:** 0**Contribution to the Project:** Dr. Romero contributed to the Center on the visualization and outreach activities; he contributed to the 3D Models of Earth subproject.**Funding Support:** Funded by Cyber-ShARE award**International Collaboration:** No**International Travel:** No**Diego Aguirre****Email:** daguirre@miners.utep.edu**Most Senior Project Role:** Graduate Student (research assistant)**Nearest Person Month Worked:** 5**Contribution to the Project:** Graduate Research Assistant contibuted to Cyber-ShARE under the Knowledge subproject**Funding Support:** Funded by Cyber-ShARE award**International Collaboration:** No**International Travel:** No**Brenda Arellano****Email:** brarellano@miners.utep.edu**Most Senior Project Role:** Graduate Student (research assistant)**Nearest Person Month Worked:** 5**Contribution to the Project:** CASSMAR Project**Funding Support:** CASSMAR Project Affiliate 14-6480-9012**International Collaboration:** No**International Travel:** No**Jitin Arora****Email:** jarora@miners.utep.edu

**Most Senior Project Role:** Graduate Student (research assistant)

**Nearest Person Month Worked:** 0

**Contribution to the Project:** Graduate Research Assistant contibuted to Cyber-ShARE under the knowledge subproject

**Funding Support:** Funded by Cyber-ShARE award

**International Collaboration:** No

**International Travel:** No

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**Carmen E Avila**

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**Most Senior Project Role:** Graduate Student (research assistant)

**Nearest Person Month Worked:** 0

**Contribution to the Project:** Graduate Research Assistant contibuted to Cyber-ShARE under the knowledge subproject

**Funding Support:** Funded by Cyber-ShARE award

**International Collaboration:** No

**International Travel:** No

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**Sergio H Celis**

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**Most Senior Project Role:** Graduate Student (research assistant)

**Nearest Person Month Worked:** 5

**Contribution to the Project:** Graduate Research Assistant contributed to Cyber-ShARE under the Environmental subproject

**Funding Support:** Funded by Cyber-ShARE award

**International Collaboration:** No

**International Travel:** No

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**Cesar R Chacon**

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**Most Senior Project Role:** Graduate Student (research assistant)

**Nearest Person Month Worked:** 0

**Contribution to the Project:** Graduate Research Assistant contributed to Cyber-ShARE under the Environmental subproject

**Funding Support:** Funded by Cyber-ShARE award

**International Collaboration:** No

**International Travel:** No

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**Ryan P Cody**

**Email:** rpcody@utep.edu

**Most Senior Project Role:** Graduate Student (research assistant)

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**Nearest Person Month Worked:** 2

**Contribution to the Project:** Graduate Research Assistant contributed to Cyber-ShARE under the Environmental subproject

**Funding Support:** Funded partially by ARMAP grant (816916) and BAID grant (ARC-1023654)

**International Collaboration:** No

**International Travel:** No

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**Mayra Contreras**

**Email:** mjcontreras@miners.utep.edu

**Most Senior Project Role:** Graduate Student (research assistant)

**Nearest Person Month Worked:** 5

**Contribution to the Project:** CASSMAR Project

**Funding Support:** CASSMAR 14-6480-9012

**International Collaboration:** No

**International Travel:** No

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**Walter Copenhaver**

**Email:** wcopenhaver@utep.edu

**Most Senior Project Role:** Graduate Student (research assistant)

**Nearest Person Month Worked:** 3

**Contribution to the Project:** Cyber-ShARE Ecosystem Processes

**Funding Support:** Cyber-ShARE Ecosystem Processes Phase 2

**International Collaboration:** No

**International Travel:** No

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**Nicholas R Del Rio**

**Email:** ndel2@miners.utep.edu

**Most Senior Project Role:** Graduate Student (research assistant)

**Nearest Person Month Worked:** 6

**Contribution to the Project:** Post-Doc working on VLC and iLink subproject

**Funding Support:** Funded by CI-Team (OCI 1135525) and NSF HRD-1242122

**International Collaboration:** No

**International Travel:** No

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**Alla K Dove**

**Email:** akdove@miners.utep.edu

**Most Senior Project Role:** Graduate Student (research assistant)

**Nearest Person Month Worked:** 0

**Contribution to the Project:** Undergraduate Research Assistant contributed to Cyber-ShARE under the Knowledge subproject

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**Funding Support:** Funded by Raytheon (SPN01268)

**International Collaboration:** No

**International Travel:** No

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**Guillermo Flores**

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**Most Senior Project Role:** Graduate Student (research assistant)

**Nearest Person Month Worked:** 0

**Contribution to the Project:** Graduate Research Assistant contributed to Cyber-ShARE under the Environmental subproject

**Funding Support:** Funded by Cyber-ShARE award

**International Collaboration:** No

**International Travel:** No

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**Aida Gandara**

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**Most Senior Project Role:** Graduate Student (research assistant)

**Nearest Person Month Worked:** 6

**Contribution to the Project:** Graduate Research Assistant and post-doc contributed to Cyber-ShARE under the Knowledge subproject

**Funding Support:** Funded by Cyber-ShARE award

**International Collaboration:** No

**International Travel:** No

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**Ariel Garcia**

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**Most Senior Project Role:** Graduate Student (research assistant)

**Nearest Person Month Worked:** 2

**Contribution to the Project:** Graduate Research Assistant contributed to Cyber-ShARE under the Knowledge subproject

**Funding Support:** Funded partially by Cyber-ShARE award and CI-Team (OCI 1135525)

**International Collaboration:** No

**International Travel:** No

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**Angel Fernando Garcia Contreras**

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**Most Senior Project Role:** Graduate Student (research assistant)

**Nearest Person Month Worked:** 0

**Contribution to the Project:** Graduate Research Assistant contributed to Cyber-ShARE under the Knowledge subproject

**Funding Support:** Funded partially by Cyber-ShARE award and Raytheon (SPN01268)

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**International Collaboration:** No

**International Travel:** No

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**Javier Eduardo Garza**

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**Most Senior Project Role:** Graduate Student (research assistant)

**Nearest Person Month Worked:** 5

**Contribution to the Project:** Graduate Research Assistant contibuted to Cyber-ShARE under the Knowledge subproject

**Funding Support:** Funded partially by Cyber-ShARE award and CI-Team (OCI 1135525)

**International Collaboration:** No

**International Travel:** No

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**Antonio Garza**

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**Most Senior Project Role:** Graduate Student (research assistant)

**Nearest Person Month Worked:** 0

**Contribution to the Project:** Graduate Research Assistant contibuted to Cyber-ShARE under the Knowledge subproject

**Funding Support:** Funded by Cyber-ShARE award

**International Collaboration:** No

**International Travel:** No

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**Matthew Giandoni**

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**Most Senior Project Role:** Graduate Student (research assistant)

**Nearest Person Month Worked:** 2

**Contribution to the Project:** Graduate Research Assistant contibuted to Cyber-ShARE under the Knowledge subproject

**Funding Support:** Funded by CI-Team (OCI 1135525)

**International Collaboration:** No

**International Travel:** No

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**Madhulatha Hari**

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**Most Senior Project Role:** Graduate Student (research assistant)

**Nearest Person Month Worked:** 0

**Contribution to the Project:** Graduate Research Assistant contibuted to Cyber-ShARE under the Knowledge subproject

**Funding Support:** Funded by I3 (DUE-0963648)

**International Collaboration:** No

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**International Travel:** No

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**Aline Jaimes**

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**Most Senior Project Role:** Graduate Student (research assistant)

**Nearest Person Month Worked:** 2

**Contribution to the Project:** Graduate Research Assistant contributed to Cyber-ShARE under the Environmental subproject

**Funding Support:** Funded by Cyber-ShARE award

**International Collaboration:** No

**International Travel:** No

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**Young-An Kim**

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**Most Senior Project Role:** Graduate Student (research assistant)

**Nearest Person Month Worked:** 0

**Contribution to the Project:** Graduate Research Assistant contibuted to Cyber-ShARE under the Knowledge subproject

**Funding Support:** Funded by NASA (NNX12AF49A)

**International Collaboration:** No

**International Travel:** No

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**Christine Marie Laney**

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**Most Senior Project Role:** Graduate Student (research assistant)

**Nearest Person Month Worked:** 6

**Contribution to the Project:** Graduate Research Assistant contributed to Cyber-ShARE under the Environmental subproject

**Funding Support:** Funded by EPA STAR Fellowship Award (FP-91728501-0)

**International Collaboration:** No

**International Travel:** No

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**Leonardo O Lerma**

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**Most Senior Project Role:** Graduate Student (research assistant)

**Nearest Person Month Worked:** 5

**Contribution to the Project:** Graduate Research Assistant contibuted to Cyber-ShARE under the Knowledge subproject

**Funding Support:** Funded by CI-Team (OCI 1135525)

**International Collaboration:** No

**International Travel:** No

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**What other organizations have been involved as partners?**

<b>Name</b>	<b>Type of Partner Organization</b>	<b>Location</b>
Ameriflux	Other Nonprofits	LBNL
Computing Alliance of Hispanic-Serving Institutions	Other Organizations (foreign or domestic)	UTEP
GEON	Other Organizations (foreign or domestic)	San Diego Supercomputing Center
Los Alamos National Lab	Other Nonprofits	New Mexico
National Ecological Observatory Network, Inc	Other Nonprofits	Boulder, CO
New Mexico State University	Academic Institution	Las Cruces, NM
Raytheon	Industrial or Commercial Firms	Los Angeles, California
Smithsonian Latino Center	State or Local Government	Washington DC
USDA Jornada Long-Term Ecological Network	Other Organizations (foreign or domestic)	Las Cruces, NM
UT Austin Texas Advanced Computing Center	Academic Institution	Austin, Texas

**Full details of organizations that have been involved as partners:****Ameriflux****Organization Type:** Other Nonprofits**Organization Location:** LBNL**Partner's Contribution to the Project:**

In-Kind Support

**More Detail on Partner and Contribution:** Advice on the establishment of field based instrumentation and ancillary cyberstructure challenges for the biogeosciences**Computing Alliance of Hispanic-Serving Institutions****Organization Type:** Other Organizations (foreign or domestic)**Organization Location:** UTEP**Partner's Contribution to the Project:**

Facilities

Collaborative Research

**More Detail on Partner and Contribution:** Students funded by CAHSI work on research using the Mentor-Grad model; students attend Fellow-NET and Affinity Research Group workshops; student participate in SACNAS through

CAHSI participation.

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## GEON

**Organization Type:** Other Organizations (foreign or domestic)

**Organization Location:** San Diego Supercomputing Center

**Partner's Contribution to the Project:**

Collaborative Research

**More Detail on Partner and Contribution:**

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## Los Alamos National Lab

**Organization Type:** Other Nonprofits

**Organization Location:** New Mexico

**Partner's Contribution to the Project:**

Financial support

Collaborative Research

**More Detail on Partner and Contribution:** LANL has provided funds for Francesca Samsel to work on designing colormaps and glyphs for scientific visualization that enable clear intuitive understanding of the data. Underdevelopment will be a means of visually differentiating data to alleviate change blindness. Colormaps and sets of glyphs will be formulated to enable scientists to highlight specific features within the visualization. Sets of colormaps and glyphs customized to specific purposes and types of visualizations will be developed.

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## National Ecological Observatory Network, Inc

**Organization Type:** Other Nonprofits

**Organization Location:** Boulder, CO

**Partner's Contribution to the Project:**

In-Kind Support

**More Detail on Partner and Contribution:** Advice on the establishment of field based instrumentation and ancillary cyberstructure challenges for the Ecological Sciences

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## New Mexico State University

**Organization Type:** Academic Institution

**Organization Location:** Las Cruces, NM

**Partner's Contribution to the Project:**

Collaborative Research

**More Detail on Partner and Contribution:** Cyber-ShARE is working with Enrico Pontelli and Huiping Cao on developing the cyberinfrastructure needed to share best practices across institutions.

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## Raytheon

**Organization Type:** Industrial or Commercial Firms

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**Organization Location:** Los Angeles, California

**Partner's Contribution to the Project:**

Financial support

**More Detail on Partner and Contribution:** Raytheon funded the GeoCaching project that involves staff, students, and researchers from Cyber-ShARE.

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**Smithsonian Latino Center**

**Organization Type:** State or Local Government

**Organization Location:** Washington DC

**Partner's Contribution to the Project:**

In-Kind Support

Collaborative Research

**More Detail on Partner and Contribution:** Smithsonian Latino Center's (SLC) resources are being used to motivate and prepare Latino students for STEM careers. We are working on the LVM Watershed project.

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**USDA Jornada Long-Term Ecological Network**

**Organization Type:** Other Organizations (foreign or domestic)

**Organization Location:** Las Cruces, NM

**Partner's Contribution to the Project:**

Facilities

Personnel Exchanges

**More Detail on Partner and Contribution:** Cyber-ShARE established an Eddy Covariance tower and robotic tram that collects data at the site.

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**UT Austin Texas Advanced Computing Center**

**Organization Type:** Academic Institution

**Organization Location:** Austin, Texas

**Partner's Contribution to the Project:**

In-Kind Support

Facilities

Collaborative Research

**More Detail on Partner and Contribution:** TACC has provided expertise on the Visualization Wall; staff has provided workshops to Cyber-ShARE and university faculty.

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**Have other collaborators or contacts been involved? No**

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## Impacts

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

The grant has impacted the Computational Science graduate program and courses in computer science (Interval Computations, Software Engineering, and independent studies). The center's novel and robust approaches are being

introduced in graduate coursework in geological and environmental sciences.

The current results of the iLink subproject research have informed the Computer Science community about methodologies for sharing, reusing and integrating scientific data. Previous results of this project have provided methods, tools and best practices on creation, use and visualization of provenance, in particular using the recently recommended (April 2013) provenance language PROV-O. Current efforts include the investigation of the role of provenance in ontology mapping, an important task in the semantic-based integration of data. Results in the semantic-based choreography of web services for the integration and visualization of scientific data has informed the Computer Science community about the limitations of current techniques as well as proposed extensions. Based on the experience in the training of the next generation of cyberinfrastructure-savvy professionals, an on-line course and a series of workshops have been developed and are offered as part of the Center's training program.

### What is the impact on other disciplines?

Cyber-ShARE's Visualization Cluster resources have been extended to various on-going projects with researchers from Geology, Electrical and Computer Engineering, Biology, Computational Science.

Francesca Samsel in collaboration with Dr. Craig Tweedie created a visualization of his environmental research for Cyber-ShARE's visualization wall called *Turbulence and Topography*. The visualization, *Turbulence and Topography*, melds the data, graphs, photographs and drawings, to create a visual exploration for the viewer; the researchers monitor, map and evaluate the ongoing physical changes in the arctic environment of Barrow, Alaska and the Chihuahuan Desert of New Mexico. Over the past year, Francesca has been describing *Turbulence and Topography* in presentations as follows:

The work with STEAM has been disseminated by Francesca Samsel as follows:

- **2014 Frontiers of Visualization**, Invited speaker, sponsored by NITRD at the National Science Foundation, Washington D.C. *This was a gathering of 22 nationally recognized professionals in visualization brought together to help the agencies of the Federal government plan policy direction for the next decade.*
- **Computer Graphics Forum**, Invited speaker, sponsored by the DOE, Argonne National Labs, Lemont, IL. *This is an annual gathering of the leaders in visualization from the national labs and major universities working with the Labs in visualization.*
- **ATX LASER** - Art Science Evening Rendezvous, Inaugural Events speaker, moderated by JD Talasek, Director, Culture Programs at the National Academy of Sciences, Lecture series at the Umlauf Museum, Austin, TX
- **Duke University**, Media Arts and Sciences Rendezvous, "Creating Mutually Beneficial Multiple-Outcome Collaborations", Invited Speaker, Raleigh, NC, **Duke Visualization Friday Forum**, Department of Computer Science, Invited Speaker, Duke University, Raleigh, NC
- **IEEE Vis 2013**, *Art, Science, Visualization Collaborations, Examining the Spectrum*, In Proceedings of the IEEE VIS Arts Program (VISAP), Atlanta, Georgia, October 2013 [http://visap2013.sista.arizona.edu/papers/Samsel\\_ExaminingTheSpectrum.pdf](http://visap2013.sista.arizona.edu/papers/Samsel_ExaminingTheSpectrum.pdf)
- **NSF / NEA SEAD Network conference speaker**, NSF, NEA and the Smithsonian co-sponsored Invitational Conference, *Speaker, Art-Science-Research Collaborations*, Smithsonian Institute, Washington, DC <http://sead.viz.tamu.edu/projects/conference.html>
- **HCI – ISE**, Human Computer Interaction and Informal Science Education Conference, Invitational, Sponsored by IDEUM and NSF, Albuquerque, NM
- **Texas A & M Visualization Department**, Invited speaker, College Station, TX

### What is the impact on the development of human resources?

The collaboration among members of the three Cyber-ShARE projects results in integration of knowledge from geosciences, computer science, computational science, environmental science, and engineering. Through these highly interdisciplinary projects, the Cyber-ShARE Center actively prepares the next-generation scientist and engineer who can work on diverse teams with knowledge of using cyberinfrastructure (CI). The professional development workshops provide training in CI middleware, visualization, as well as professional, research, collaboration, and team skills. The outreach components involve students in activities that include technology and science, and the courses that reach future teachers are critical to human resource development. In addition, students are exposed to cutting-edge technologies and concepts that are not typically introduced in the curriculum, and students are able to practice and hone their skills in a real application.

Cyber-ShARE promotes the involvement of students in development workshops, preparation for graduate studies, scientific symposia, and mentoring through experiences at the university and through conferences, e.g., AGU, Computing Alliance of Hispanic-Serving Institutions, and SACNAS.

### **What is the impact on physical resources that form infrastructure?**

The Cyber-ShARE Center houses a core facility for visualization. The Cyber-ShARE Collaborative Visualization System (C2ViS) Laboratory supports multidisciplinary scientific collaboration and visualization of scientific datasets for exploratory, monitoring, educational, and outreach purposes. Keith has also used the Cyber-ShARE visualization lab to analyze his coastal time series photographs.

The Cyber-ShARE Center also provides a Testing and Production level development environment through a IBM 3650 M4 server system powered by twelve 2.0GHz Intel Xeon processors, 32GB DDR3 RAM and 12TB of operational storage space. The system infrastructure is laid out into 6 separate virtual Linux servers composed of a Network File System, Network Information System, Web Server, Database Server, Versioning Control System and an Application Server for in-house development. In addition, the center equips a supplementary 12TB of storage space by means of a Dell EqualLogic storage solution.

### **What is the impact on institutional resources that form infrastructure?**

Cyber-ShARE has contributed to the development of the Expertise Connector system to manage expertise and community building.

### **What is the impact on information resources that form infrastructure?**

Cyber-ShARE has introduced technology to support data and information management.

### **What is the impact on technology transfer?**

Nothing to report.

### **What is the impact on society beyond science and technology?**

Cyber-ShARE is preparing cohorts of students with 21st century demographics and skills. These students are well prepared to address the scientific challenges facing society through global change, through deep expertise in their selected discipline and cross-cutting capabilities in the design and use of cyberinfrastructure; teamwork and collaboration; and interdisciplinary research integration.

Cyber-ShARE's efforts at UTEP have contributed to establishing a culture that promotes interdisciplinary research and creative efforts. This has included the creation of communities of practice, i.e., groups of people who share a concern or a passion for something they do and learn how to do it better as they interact regularly (Wenger). The communities are being built around effective educational practices (with a focus on increasing exchange of best practices, guidelines, and procedures; learning from others; accelerating decision making; and identifying experts) and research (with a focus on sharing expertise, knowledge, infrastructure, and information; provide documentation of efforts; and providing shared understanding of needs and problems to be solved).

The tools developed by the Cyber-ShARE Center can be used by researchers and educators beyond science and technology. For example, MetaShare, a knowledge-based system that supports the creation of data management plans, can be used to annotate data with metadata and support discovery and retrieval of data and knowledge.

Cyber-ShARE's work with artist Francesca Samsel illustrates how visualization can help scientists analyze and communicate their research findings.

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## **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.