SI2-SSI: Community Software for Extreme-Scale Computing in Earthquake System Science (SEISM2)

Wrap-up Session

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SCEC SEISM2 Proposal

SCEC's SI2-SSI: Community Software for Extreme-Scale Computing in Earthquake System Science (SEISM2) Project will push validated simulation capabilities to higher seismic frequencies by addressing scientific problems that limit the accuracy and scale in current numerical representations of earthquake processes. Project software development will address three main computational requirements:

(1) Extend earthquake simulations to higher seismic frequencies.

(2) Validate simulations against existing earthquake data and empirical GMPEs.

(3) Decrease the time-to-solution of SEISM simulations and physics-based seismic hazard models.

SCEC SEISM2 Award Details

Name: SI2-SSI: Community Software for Extreme-Scale Computing in Earthquake System Science (ACI-1450451)

Division of Advanced Cyberinfrastructure Programs (ACI)

Software Infrastructure for Sustained Innovation - SSE & SSI (SI2 - SSE&SSI)

II. PROGRAM DESCRIPTION

The goal of the SI2 program is to create a software ecosystem that scales from individual or small groups of software innovators to large hubs of software excellence. The program includes three classes of awards:

1. Scientific Software Elements (SSE)

2. Scientific Software Integration (SSI)

3. Scientific Software Innovation Institutes (S2I2) -> co-Design?

SCEC Scientific Software Distributions

CME Scientific Software Distributions

Software Distribution	Scientific Application	Software Homepage
AWP-ODC	Parallel finite difference earthquake wave propagation code	AWP-ODC
Broadband Platform	Ground motion simulation software	Broadband Platform
Community Velocity Model - Harvard (CVM-H)	3D seismic velocity model for southern California	CVM-H
Community Velocity Model - SCEC (CVM-S)	3D seismic velocity model for southern California	CVM-S
CSEP	Earthquake forecast testing framework	CSEP
Hercules	Parallel finite element earthquake wave propagation code	https://github.com/CMU-Quake/hercules
OpenSHA	USGS and SCEC-developed seismic hazard analysis software	http://www.opensha.org/
SCEC-VDO	3D visualization software used to display fault models and earthquake catalogs	http://scec.usc.edu/internships/useit/scec-vdo
Unified Community Velocity Model (UCVM)	Software framework for querying seismic velocity models	UCVM

Related Scientific Software Community

Division of Advanced Cyberinfrastructure Programs (ACI)

Katz, Daniel S. and Ramnath, Rajiv. (2015) Looking at Software Sustainability and Productivity Challenges from NSF. arXiv.org, 17 August 2015, http://arxiv.org/abs/1508.03348

Software Attribution for Geoscience Applications (SAGA) : The SAGA seeks to develop a usable software tool for citation of open source software that describes the software environment and contributions from multiple authors. https://geodynamics.org/cig/projects/saga/

CIG workshop on "Software Citation: Beyond the Research Paper", October 29-30, 2015 in Davis, CA. This is a workshop of the Software Attribution for Geoscience Applications (SAGA) project.

3rd Workshop on Sustainable Software for Science Practice and Experiences (WSSSPE3) September 28-29, 2015, Boulder, CO

http://wssspe.researchcomputing.org.uk/wssspe3/

Scientific Software Community Discussions

Science Code Manifesto

Manifesto Discussion Endorse Resources About

Software is a cornerstone of science. Without software, twenty-first century science would be impossible. Without better software, science cannot progress.

But the culture and institutions of science have not yet adjusted to this reality. We need to reform them to address this challenge, by adopting these five principles:

Code All source code written specifically to process data for a published paper must be available to the reviewers and readers of the paper.

Copyright The copyright ownership and license of any released source code must be clearly stated.

Citation Researchers who use or adapt science source code in their research must credit the code's creators in resulting publications.

Credit Software contributions must be included in systems of scientific assessment, credit, and recognition.

Curation Source code must remain available, linked to related materials, for the useful lifetime of the publication.

Founding Signatories

Nick Barnes David Jones

Further Reading

- Climate Code Foundation
- Panton Principles
- Open Knowledge Definition

SEISM2 Project Milestones

Timeline, Milestones, and Responsibilities. In our revised workplan, we define 14 (was 17) milestones (M1-M14) over the course of the 3-year project. The milestones for each of the three project objectives O1-O3 track a 4-step iterative process for SSE development: improve, evaluate, release, and apply. Each milestone requires the re-integration of one or more SEISM platforms.

Year 1:
- **M1: AWP-ODC released with near fault plasticity (O1)**
- **M2: Hercules released with frequency-dependent attenuation (O1)**
- **M3: Simulations validated against historic events using using SWUS procedures (O2)**
- **M4: CyberShake 1Hz Los Angeles hazard model (O1)**

Year 2:
- **M5: Integrate SEISM-IO Library into AWP for checkpointing (O3)**
- **M6: Hercules released with nonlinear plastic yielding (O1)**
- **M7: Prototype of parallel discontinuous mesh AWP-DM (O3)**
- **M8: Simulations validated against historic events using GMSV SDoF Procedures (O2)**
- **M9: CyberShake 1.5Hz LA hazard model (O1)**

Year 3:
- **M10: Parallelization and optimization of discontinuous mesh AWP-DM (O3)**
- **M11: CyberShake SGT data used by Broadband platform (O1)**
- **M12: High-complexity ShakeOut simulation (O3)**
- **M13: AWP-ODC ported onto MIC (O3)**
- **M14: CyberShake EKS hazard model (O1)**

The project scientists responsible for O1 (physics) are Jordan, Olsen, and Bielak; for O2 (validation) Taborda, Goulet, and Olsen; and for O3 (performance) Cui and Maechling.

SCEC SEISM2 on NSF Web Site

Simple Search Results

Search award for: "SCEC"

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NSF Organization

- Direct For Computer & Info Scie & Enginr (4)
- Directorate For Geosciences (2)

Award Amount

- Less than or equal $50,000 (1)
- Between $100,001 - $500,000 (2)
- More than $1,000,000 (3)

Award Instrument

- Standard Grant (3)
- Continuing Grant (1)
- Cooperative Agreement (1)
- Fellowship (1)

REU Site: Undergraduate Studies in Earthquake Information Technology (SCEC/UseIT)
Award Number:1263272; Principal Investigator:Thomas Jordan; Co-Principal Investigator:; Organization:University of Southern California;NSF Organization:ACI Start Date:05/01/2013; Award Amount:$360,000.00; Relevance:43.06;

SI2-SSI: Community Software for Extreme-Scale Computing in Earthquake System Science
Award Number:1450451; Principal Investigator:Thomas Jordan; Co-Principal Investigator:Kim Olsen, Yifeng Cui, Ricardo Taborda; Organization:University of Southern California;NSF Organization:ACI Start Date:09/01/2015; Award Amount:$2,200,000.00; Relevance:41.67;

The Southern California Earthquake Center, Phase 4 (SCEC4): Tracking Earthquake Cascades
Award Number:1033462; Principal Investigator:Thomas Jordan; Co-Principal Investigator:; Organization:University of Southern California;NSF Organization:EAR Start Date:02/01/2012; Award Amount:$12,450,000.00; Relevance:40.96;

SI2-SSI: A Sustainable Community Software Framework for Petascale Earthquake Modeling
Award Number:1148493; Principal Investigator:Thomas Jordan; Co-Principal Investigator:Kim Olsen, Yifeng Cui, Jacobo Bielak; Organization:University of Southern California;NSF Organization:ACI Start Date:08/01/2012; Award Amount:$2,522,784.00; Relevance:36.1;

Extending the Spatiotemporal Scales of Physics-Based Seismic Hazard Analysis
Award Number:1440085; Principal Investigator:Thomas Jordan; Co-Principal Investigator:Jacobo Bielak, Kim Olsen, Yifeng Cui; Organization:University of Southern California;NSF Organization:ACI Start Date:09/01/2014; Award Amount:$40,000.00; Relevance:36.1;

SCEC Blue Waters Project

Extending the Spatiotemporal Scales of Physics-based Seismic Hazard Analysis (OCI-1440085) large-scale simulation targeted at three primary objectives:

O1. Validation of high-frequency simulations (up to 8 Hz) against seismic recordings of historical earthquakes, such as the 1994 Northridge earthquake (M 6.7).

O2. Computation of 2-Hz CyberShake hazard model for the Los Angeles region as input to the development of high-resolution urban seismic hazard maps by the USGS and SCEC.

O3. High-frequency (4 Hz) simulation of a M7.8 earthquake on the San Andreas fault that will revise the 2008 Great California ShakeOut scenario and improve the risk analysis developed in detail for this Scenario

SEISM2 Year 1 Project Milestones

Milestones for Next Year's SCEC Annual Meeting 2016:

M1: AWP-ODC released with near fault plasticity (O1)
M2: Hercules released with frequency-dependent attenuation (O1)
M3: Simulations validated against historic events using using SWUS procedures (O2)
M4: CyberShake 1Hz Los Angeles hazard model (O1)

The project scientists responsible for O1 (physics) are Jordan, Olsen, and Bielak; for O2 (validation) Taborda, Goulet, and Olsen; and for O3 (performance) Cui and Maechling.

SEISM2 Project Logistics:

Public Interface:

Wiki Site with Links to Relevants Results

Project Interfaces:

Login-required web site access

Project email subscription list

Quarterly group status calls for all funded groups

Project objectives for Y1 are consistent with ongoing High-F, CyberShake, and Broadband, Blue Waters PRAC activities.

Project participants are asked to contribute to project NSF reports.

Project participants are asked to contribute to HPC allocations and to report accomplishments using allocations.

Science Goals:

SEISM2 software will support the computational requirements of SCEC projects including High-F, BBP, CyberShake, Ground Motion Simulation Validation (GMSV), and Committee for Utilization of Ground Motion Simulations (UGMS)

Sustainable Scientific Software Goals:

SCEC has special, valuable, expertise in scientific software and should encourage computer skills in sciencies, software projects in NSF, ongoing training for staff.

Consistent with SI2 program goals, our SEISM2 project will continue to improve our practices and processes for converting research code into community codes.

Thank you!