

SCEC Award # 19181**Ground Motion Simulation Validation (GMSV) Technical Activity Group (TAG) Workshop**

Amount Requested: \$10,000

Categories: Technical Activity Groups (TAGs) / Workshops

Science Priorities: P4.d, P4.b, P4.c

Principal Investigators: Sanaz Rezaeian (USGS) and Jonathan Stewart (UCLA)**Technical Report:****Background:**

The SCEC Ground Motion Simulation Validation (GMSV) Technical Activity Group (TAG) was initiated in SCEC4 and continued into SCEC5 to develop and implement, via collaboration between ground motion modelers and engineering users, testing/rating methodologies for the use of ground motion simulations in engineering applications. The TAG has served as an umbrella under which independently funded GMSV-related projects are coordinated through periodic web-conferences and occasional in-person meetings. The continuation of the GMSV TAG into SCEC5, was funded under the Award # 17185. The five-year (2017 to 2022) goal of this group is to (1) identify areas of bias in SCEC simulated ground motions with respect to observations, so as to facilitate continued improvements of simulation routines that hopefully remove bias and produce appropriate levels of dispersion; and (2) help engineers to gain confidence in utilizing simulated ground motions by demonstrating the ability of simulations to provide unbiased predictions of ground shaking and unbiased results from response history analyses in various engineering applications.

Under the SCEC award #19181, we proposed to continue coordination between independently funded GMSV-related projects through web-conferences and requested funding for an in-person workshop during 2019. We organized the “2019 SCEC Funded GMSV-Related Projects” into three groups (see Table 1 for details on each project):

- (1) Five Core GMSV-Related Projects: 19181, 19173, 19060, 19152, 19114
- (2) Three Geotechnical (Site Module) GMSV-Related Projects: 19097, 19055, 19150
- (3) Three Other Related Projects to Coordinate with: 19091, 19053, 19077

The GMSV TAG’s coordination efforts in 2019, including the list of projects, periodic conference calls, workshops and meetings are provided on our SCEC5 GMSV TAG Google Website at <https://sites.google.com/view/scec5-gmsv-tag/home>, and are summarized below.

2019 Coordination Efforts:

Web-conferences were organized by the TAG starting in June 2019 to coordinate the projects listed in Table 1. We had hoped to start this coordination earlier in 2019, but our work was delayed due to the timing of SCEC’s decision regarding funded/rejected projects. Eight coordination calls were held in 2019 on June 12, June 26, July 17, July 24, August 1, September 25, October 9, and November 13. The latest call was organized recently on April 1, 2020. The agenda and details for all the coordination calls can be found on the GMSV Website:

<https://sites.google.com/view/scec5-gmsv-tag/home>

In addition to the web-conferences, a small workshop was held on December 6, 2019, at the SCEC headquarters in Los Angeles, CA. More details about this workshop and the summary of outcomes are provided in the next section. Workshop Website: <https://www.scec.org/workshops/2019/gmsv>

Finally, a special session was organized on March 6, 2020, at the National Earthquake Conference (NEC) in San Diego, CA, led by Dr. Zareian and co-organized by Dr. Rezaeian and Dr. Goulet, during which several of the SCEC GMSV related projects were presented. More information is available at: http://earthquakeconference.org/pdf/NEC_Program.pdf

Dec 6, 2019, Workshop / Working Meeting:

Ground motion simulation validation-related research has maximum impact when goals are clearly articulated and connected to practical needs. Most impact is achieved when results (a) provide guidance on what methods are suitable for use “now” and (b) inform ground motion modelers how to improve their methods for “future” use. In 2018, the GMSV TAG convened two workshops, one with practicing engineers in February, and one planning workshop with experts from the ground motion prediction and earthquake engineering communities in August 2018 with the goal to clearly define and steer the SCEC GMSV program in the most impactful directions. Based on the recommendations from these workshops, several multi-PI collaborative proposals were submitted to SCEC in response to the 2019 RFP. The proposed workshop under the Award #19181 was envisioned to be held at the SCEC Annual Meeting with the goal to coordinate between the funded multi-PI projects with the outcome used to define clear long-term goals for the GMSV TAG.

However, our plans for this workshop were modified as we coordinated with the SCEC Award #19173, a multi-PI project with six of the main GMSV PIs. The purpose of this project was to develop a “Guidelines Document on Utilization of Simulations for Engineering Building Response Applications.” Since this project did not receive its requested funding for an in-person meeting, we decided to redirect the focus of our workshop and instead hold a small working meeting with a few invited practicing engineers and experts who could help the GMSV TAG in development of the envisioned document.

The goal of this workshop (i.e., working meeting), convened on Dec 6 2019, was to help engineers gain confidence in utilizing simulated ground motions. A draft of a guidelines document on utilization of SCEC simulations for engineering building response applications in the U.S. was distributed to the attendees pre-workshop. During the workshop, we discussed this document in order to modify and finalize it, but we also discussed possible future documents and follow up GMSV studies. See the workshop’s Website for agenda and a list of attendees: <https://www.scec.org/workshops/2019/gmsv> . Background material from previous two GMSV workshops were also sent to the attendees:

- February 16, 2018, Workshop With Practicing Engineers: <https://www.scec.org/workshops/2018/gmsv>
Survey: https://docs.google.com/spreadsheets/d/1-lvfYAhkf3Z7fBl7bdkBngbH_VbSX6tC4tmFh28bO0/edit?usp=sharing
- August 24, 2018, GMSV Planning Workshop: <https://www.scec.org/workshops/2018/gmsv-aug>
Discussion Questions (see the “Afternoon Session”):
https://docs.google.com/document/d/1cNKu-Nr-ifQ63iP_QnXRwNaNQnCwbsxIK-PbDFbui5I/edit?usp=sharing
- December 6, 2019, GMSV Workshop / Working Meeting:
<https://www.scec.org/workshops/2019/gmsv>

Summary of Feedback Received During the Dec 6 Workshop / Working Meeting:

Specific feedback was received regarding the guidelines document from the attendees that are not all listed here (see project report of Award #19173 for the status of the document). The more general comments currently under consideration for revising the document (and also applicable to other guidelines documents that the GMSV TAG could produce in the future) are summarized below:

1. Think about the intended audience:

The practicing engineers felt that we need to better describe the intended audience (in the introduction). We decided that we want to target something in between “engineers who want to do their own simulations” and “engineers who want to use a vetted set of simulations.”

- Think about these questions: Are we targeting the average or expert engineers? Structural or geotechnical engineers? Average or expert geotechnical engineers who do peer reviews of tall buildings?
- It was suggested to avoid referring to the reduced set of motions as “vetted” – it implies less confidence in equivalently derived motions from same procedures. One suggested/preferred terminology was “representative of the simulated database”

2. Better describe the need for simulations up front:
 - As a way to sell the need for simulations up front – have a colorful graphic with magnitude-distance plots for NGA and simulations side-by-side; this will show the large population of large magnitude and short distance data for simulations. Could also do this in map figure.
 - Up front mention that simulations are good these days and can be used in place of recordings in many situations -- we are being too modest in “selling” the simulations to the engineering users to the point that it’s confusing to the engineers if simulations are even good. Most engineers don’t doubt the technical validity of simulations if we consider them good to be used in practice, they just don’t know which simulations to use.
 - Better describe the problems with the current practice of scaling and spectrum matching of recordings up front to justify the need for simulations.
3. Better describe the need for simulations through examples at the end:
 - Try to find an example where the use of simulated motions makes a difference in the structural demand assessment – perhaps through durations.
 - A possible selling point for simulations is that they capture the Sa-Duration correlations, and as such are well suited to represent these features in the selected suite of motions.
 - Consider including figures that show differences between simulations and recordings in tall building response
4. “Guidelines & Recommendations” detail level (balance between “general” and “specific”):
 - It was noted that the guidelines sent pre-workshop were too general and if this document was to be used in any future form of regulations (e.g., NEHRP part 3 paper was mentioned), the engineers would desire a more detailed “checklist”. However, it was also noted that such a checklist does not even exist for selection and scaling of recorded ground motions in current practice, so we cannot be too specific either.
 - Another view was that in this paper we should keep the guidelines “general enough” so that they can be applied to all simulations (e.g., outside SCEC). This paper should close by showing some SCEC simulations as an example of applying the guidelines and demonstrate how we checked off each bullet point in the envisioned list. In this way, subsequent studies/papers could apply these guidelines (or checklist) to other simulations.
 - The use of a table similar to the one shown in Bradely et al. (2017) was considered desirable, showing which simulations check with what bullet points from the “guidelines.”
5. Discuss the issue of what to do with variable demands from natural and simulated records:
 - Start with a careful look at the Intensity Measures (e.g., Sa, duration). These will probably explain the difference.
 - Provide some input on how much of a difference is “significant.”
6. Comment on dissemination and search interface for simulated motions:

Various search options were discussed, including:

 - Using a target spectrum as an input to a webservice and letting that webservice to select compatible simulations within scaling limits
 - Use traditional search criteria: magnitude, distance, etc.
 - Use the causative fault, or a site in a particular basin
 - Eventually: input the site’s coordinates, and the webservice would pick the closest site for a certain set of faults.
 - It was mentioned that NHERI’s website is envisioned for future distribution of simulations. Consider referring engineers to the designsafe website <https://www.designsafe-ci.org/>

Table 1. 2019 SCEC Funded Projects (coordinated under GMSV TAG)

Core GMSV-Related Projects:	
Award #19181	Ground Motion Simulation Validation (GMSV) Technical Activity Group (TAG) Workshop PI(s): Sanaz Rezaeian, Jonathan Stewart
Award #19173	SCEC Ground Motion Simulation Validation (GMSV) Guidelines on Utilization of Simulations for Engineering Building Response Applications PI(s): Ting Lin, Sanaz Rezaeian, Nicolas Luco, Gregory Deierlein, Jack Baker, Farzin Zareian
Award #19060	Selection of Time Series in Support of the Committee for Utilization of Ground Motion Simulations PI(s): Jack Baker, Sanaz Rezaeian
Award #19152	SCEC Simulation Validation for Southern California Basins using Ground Motion Recordings PI(s): Jonathan Stewart
Award #19114	Critical assessment of probabilistic seismic demand analysis of ordinary bridge structures using Cybershake simulations PI(s): Farzin Zareian, Sanaz Rezaeian
Geotechnical (Site Module) GMSV-Related Projects:	
Award #19097	Region-Specific Fourier-Based Site Amplification Modeling PI(s): Jeff Bayless, Andreas Skarlatoudis, Paul Somerville, Jonathan Stewart
Award #19055	Implementation and Validation of a Site-Specific Response Module Toolbox on the Broadband Platform PI(s): Domniki Asimaki
Award #19150	Validation of SCEC BBP nonlinear soil module PI(s): Pedro Arduino, Ertugrul Taciroglu, Mahdi Taiebat, Luis Bonilla
Other Related Projects to Coordinate with:	
Award #19091	Organizational Meetings for the SCEC Utilization of Ground-Motion Simulations (UGMS) Committee PI(s): C.B. Crouse, Christine Goulet
Award #19053	A Technical Activity Group for the coordination of SCEC5 research activities on nonlinear effects in the shallow crust: Progress and Future Plans PI(s): Domniki Asimaki, Ricardo Taborda
Award #19077	Validation of Broadband Ground Motion from Dynamic Rupture Simulations: towards better characterizing seismic hazard for engineering applications PI(s): Kyle Withers, Shuo Ma, Luis Dalguer, Jean-Paul Ampuero