SCEC Award # 18161
Ground Motion Simulation Validation (GMSV) Technical Activity Group (TAG) Workshop
Amount Requested: $10,000
Category: Workshop Proposal
Suggested Review Groups: Earthquake Engineering Implementation Interface (EEII), Ground Motions
Science Objectives: 4d
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 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. In SCEC4, the TAG served as an umbrella under which independently funded GMSV-related projects were coordinated through periodic web-conferences and meetings (for more information on SCEC4 projects and meetings, see the GMSV TAG wiki at http://collaborate.scec.org/gmsv/).

In 2017, we proposed the continuation of the GMSV TAG in SCEC5, which was funded under the SCEC Award # 17185. The five-year 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. We initiated our periodic conference calls in October of 2017 to plan for these goals and to coordinate between funded GMSV-related projects (a list of our SCEC5 projects, conference calls and meetings can be found on our SCEC5 GMSV TAG Google Website, https://sites.google.com/view/scec5-gmsv-tag/home, a copy of which is provided at the end of this report).

Workshop:

In 2018, under the SCEC Award # 18161, we held a "Planning Workshop" in order to identify a specific scope and focus for our future TAG efforts and to address the two goals of the TAG mentioned above. To aid with organization of this workshop, we recruited co-conveners Nicolas Luco (the previous TAG co-leader from USGS), Gregory Deierlein and Farzin Zareian (as our engineering experts from Stanford and UCI), and Christine Goulet (as the SCEC representative to help us coordinate our goals with other validation efforts outside of the TAG).

This was a full-day workshop at SCEC on August 24, 2018. We invited both ground motion modeling experts and engineering practitioners to help us with our decisions regarding the two goals mentioned above in the Background section. We divided the day so that we can discuss 1) GMSV related to ground motion characterization, and 2) GMSV related to building response. The workshop information, agenda, and the list of participants are provided below:

Workshop Information:

Website: https://www.scec.org/workshops/2018/gmsv-aug
Title: SCEC Ground Motion Simulation Validation Planning Workshop
Conveners: Sanaz Rezaeian, Jon Stewart, Nicolas Luco, Christine Goulet, Gregory Deierlein & Farzin Zareian

Date: August 24, 2018 (10:00 - 16:30)
Location: SCEC Boardroom, USC, Los Angeles

Workshop Agenda:

09:30 - 10:00	**Welcome and Introductions** (PDF, 4.4MB)	*Sanaz Rezaeian*
10:00 - 12:00	**GMSV Objectives and Path Forward for Ground Motion Characterization**	
10:00 - 10:20	- Background: SCEC Broadband Platform Validation and Outcomes (PDF, 1.3MB)	*Christine Goulet*
10:20 - 10:40	- Vision: Future Validation Needs for Hazard Characterization	*Yousef Bozorgnia*
10:40 - 11:30	- Breakout Group Discussions (PDF, 109KB)	*All Attendees*
11:30 - 12:00	- Summaries from Breakout Groups	
12:00 - 13:00	*Lunch*	
13:00 - 15:00	**GMSV Objectives and Path Forward for Engineering Applications**	
13:00 - 13:20	- Background: Use of SCEC Seismogram Simulations for Building Response Analysis (PDF, 3.9MB)	*Nicolas Luco*
13:20 - 13:40	- Background: New Zealand GMSV Guidelines for Engineers	*Sanaz Rezaeian*
13:40 - 14:00	- Vision: What Engineers Need in Terms of Sample Simulations and Guidelines for Use of Simulations (PDF, 4.3MB)	Gregory Deierlein
14:00 - 14:30	- Breakout Group Discussions (PDF, 109KB)	*All Attendees*
14:30 - 15:00	- Summaries from Breakout Groups	
15:00 - 16:00	**Summary and Conclusions**	*Jon Stewart*
16:00	*Adjourn*	

Workshop Participants: *(*Remote Participants)*

*Pedro Arduino (UW)	Rob Graves (USGS)	*Farzad Naeim (Naeim Assoc.)
*Domniki Asimaki (Caltech)	Jon Heintz (ATC)	Edric Pauk (SCEC)
Yousef Bozorgnia (UCLA)	Marty Hudson (AMEC)	Sanaz Rezaeian (USGS)
*Philip Caldwell (BSSC)	*Albert Kottke (PG&E)	Anoosh Shamsabadi (HSRA)
*CB Crouse (AECOM)	Jongwon Lee (ARUP)	Jon Stewart (UCLA)
Gregory Deierlein (Stanford)	Ting Lin (Texas Tech)	Ali Sumer (OSHPD)
*Josh Gebelein (Parsons)	Nico Luco (USGS)	Ertugrul Taciroglu (UCLA)
Farid Ghahari (UCLA)	Kevin Milner (SCEC/USC)	Katie Wooddell (PG&E)
Christine Goulet (SCEC/USC)	Morgan Moschetti (USGS)	Farzin Zareian (UC Irvine)

Workshop Summary & Objectives:

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. The SCEC GMSV TAG is a collaboration between ground motion modelers and engineering users, focused on developing, testing and rating methodologies for simulated ground motions to be used in engineering applications. The GMSV TAG convened a 1-day workshop, bringing together experts from the ground motion prediction and earthquake engineering communities, with the purpose of clearly defining and steering the SCEC GMSV program in the most impactful directions. The goal was to identify short- and long-term research goals for SCEC GMSV-related projects, mostly based on SCEC CyberShake simulations. Action items resulting from this workshop were envisioned to address:

1) **GMSV related needs for ground motion characterization (including GMPEs):** (1) Establish a process (similar to Dreger *et al*, 2015 for the SCEC Broadband Platform) to assess the suitability of Cybershake simulations for predicting PSA and duration in terms of mean values and trends with major controlling source, path, and site parameters. (2) Based on assessment results, work

directly with simulation model developers to improve models. (3) Critically evaluate and improve, as needed, stochastic elements of the simulation procedures to produce appropriate scaling and dispersion of high-frequency ground motions.

2) **GMSV related needs for building response:** Develop a white paper to describe how to use simulated motions for building response studies once a target response spectrum (e.g. UHS or CMS) is developed by some other process. The paper will include best practices, as we now understand them, and identify limitations to the methodology.

We discussed a few related papers during this workshop in order to address the above two objectives, these papers were provided to the workshop participants and are listed below as references:

REFERENCES

- Bijelić N, Lin T, Deierlein GG. Validation of the SCEC Broadband Platform simulations for tall building risk assessments considering spectral shape and duration of the ground motion. Earthquake Engng Struct Dyn. 2018;47:2233–2251. https://doi.org/10.1002/eqe.3066
- Brendon A. Bradley, Didier Pettinga, Jack W. Baker, and Jeff Fraser (2017) Guidance on the Utilization of Earthquake-Induced Ground Motion Simulations in Engineering Practice. Earthquake Spectra: August 2017, Vol. 33, No. 3, pp. 809-835. https://doi.org/10.1193/120216EQS219EP
- Douglas S. Dreger, Gregory C. Beroza, Steven M. Day, Christine A. Goulet, Thomas H. Jordan, Paul A. Spudich, Jonathan P. Stewart; Validation of the SCEC Broadband Platform V14.3 Simulation Methods Using Pseudospectral Acceleration Data. Seismological Research Letters; 86 (1): 39–47. doi: https://doi.org/10.1785/0220140118
- Christine A. Goulet, Norman A. Abrahamson, Paul G. Somerville, Katie E. Wooddell; The SCEC Broadband Platform Validation Exercise: Methodology for Code Validation in the Context of Seismic-Hazard Analyses. Seismological Research Letters; 86 (1): 17–26. doi: https://doi.org/10.1785/0220140104

Summary of Outcomes:

For this workshop, we provided a list of discussion questions to all participants. These questions were displayed after each session's "background" and "vision" talks in the morning and in the afternoon (see the Workshop Agenda), to discuss the GMSV related needs for 1) ground motion characterization, and 2) building response, respectively. These questions along with a summary response to each question are provided below (these are also posted on our GMSV TAG Google Website):

20180824Discussion Questions-SCEC GMSV TAG Aug24 2018:

Morning Session: GMSV in relation to ground motion characterization (including GMPEs)

1. Should we focus on validation of the current versions of simulations, or on tools for validation of current and future simulations?
   - o Focus on the tools/protocols
   - o Develop a protocol by which these validations can be performed. How do we do this for critical effects like basin effects, variability, hanging wall. These efforts force us to address a paradox, which is that we want to validate simulations to add complex effects in db, but we cannot validate against the effects we seek to study, because of lack of data. We need to validate up to some point and then go beyond that with 'trust' in the simulations for effects of interest. Where do we draw that line.
   - o Committee needs to take this up to flesh out the details.
   - o Need improved site response models for use in the validation process (FAS, etc.). the nonlinear geotech group could do this in short term

- Independence of the validation process is critical from the perspective of the end user community. However, there are different levels of independence – 'pure' independence (being completely separated from the process) is not needed.

2. What are the roles of Broadband Platform (BBP) versus Cybershake simulations moving forward?
   - Don't drop BBP now, need to look at variability within this platform
   - Cybershake validation is needed, would be especially useful for the path effects (non-ergodic applications) and site effect (basin response)
   - Have the committee take up the question for when each should be used.

3. Are high frequency components of ground motion needed as a product of physics-based simulations (f > 1-2 Hz)?
   - SCEC has written a proposal to do this. They are interested. They just need resources
   - Engineers say that this is important

4. Are vertical ground motion simulations needed?
   - The BBP produces vertical component, this could be checked
   - Would be nice to have this as part of the outputs, engineers aren't sure what to do (YB, Anoosh). Maybe not as important as getting the high frequencies resolved (GGD). Not critical for tall buildings (MBH). Important for bridges and isolated structures (Anoosh)
   - Controlling parameters (like water table depth) are not necessarily well defined.
   - It is affected by non-1D wave propagation and surface waves (Domniki)
   - Most of the discussion was on the shallow site response effect. I think the simulation validation question is more related to the source/path/crustal amp.

5. What aspects of ground motion prediction equations (GMPEs) are simulations best suited to resolve (e.g., large M scaling, basin effects, etc.)? What validation can be undertaken to provide confidence in simulations for these purposes?

6. How can uncertainties in the scaling relationships (e.g., GMPEs) be identified if there is an absence of observations?

7. How to get regionally appropriate simulations or validate them?

Afternoon Session: GMSV in relation to engineering applications

1. Organization:
   a. Should the validations be done by SCEC-funded researchers, or a group of engineering users? Or some combination of both?
      - Jon Heintz: What Ting and Greg did is directly useful. But do need to get other people involved to build up a comfort level.
      - SEAOC has seismological committee, they could get involved in serving as sounding board
      - If simulated ground motions are made available, then we need to know who is using them. Feedback mechanisms
   b. What form of communication to the professional community will be most impactful in advancing practice in this area? (e.g., a white paper on utilization of simulations in engineering applications, a NEHRP Part 3 document, *see Bradley et al. 2017 EQS paper as an example*)
      - Getting a position paper out now would be a good idea. NEHRP Part 3 and EQS opinion paper.
      - Should involve practitioners
      - Paper should address complications like version control

2. What frequency bandwidths are most relevant to what problems? Are verticals needed?

- Addressed in morning

3. What would practicing engineers like to see from validations to have confidence in using simulated ground motions for derivations of fragility? For example:
    a. Motions scaled to a spectral shape should have a reasonable range of other parameters known to affect fragility (duration etc., *see Bijelic et al. 2018 paper as an example*)
    b. Motions should have realistic period-to-period correlations.
    - Need to include bridge structures. Other types of structures?
    - Tunnels, including fling step displacement in the ground motion
    - Seismically isolated structures
    - Structures with non-structural elements

4. What are the research and development steps needed to get us to a point to provide this guidance?

5. What new topics should we pursue? For example:
    a. Validation parallel to what has been done for GMPEs, but for engineering demand parameters (EDPs)
    b. Validation for long period structures, site-specific analysis, or dams
    c. Validation for response of nonstructural components (i.e. floors spectra)

Recommended Projects:

- Site response modules for BBP
- Undertake work to encourage and enable engineering application of simulated motions for response history analysis of buildings:
    - Committee to review prior work, vett through engineering practice committees (SEAOC seismology), identify gaps (as applicable), and prepare recommendations
    - Prepare tools and protocols to facilitate access to simulated motions and appropriate selection of those motions
- Validation exercises focused on new applications (bridges, tunnels, dams, etc.)

Following the workshop, we held two meetings (one conference call, and one in-person meeting during the 2018 SCEC annual meeting in Palm Springs, CA) between the co-conveners to summarize the outcomes for our short-term goals. This summary of outcomes was presented and discussed with the entire GMSV TAG during our October 9 conference call and is outlined below. It only represents our short-term goals, for guidance on our long-term goals see the Discussion Questions above.

Summary of Outcomes (guidance for short-term goals):

During our Aug24 "Planning Workshop", we discussed what types of GMSV-related proposals should be submitted in response to the SCEC RFP this year. Three research areas were discussed that are of interest to GMSV this year:

1. Proposals related to site response modules for the BBP: Jon Stewart plans to work on a proposal with Jeff Bayless, Andreas Skarlatoudis, and Domniki Assimaki on this topic. Other related proposals are welcome, but PIs are encouraged to collaborate with this group.

2. Proposals that encourage and/or enable engineering applications of SCEC simulations for response history analysis of buildings. Examples include:

a. Forming a committee to review prior GMSV work, vett through engineering practice committees (SEAOC seismology), identify gaps (as applicable), and prepare

recommendations: We talked about a potential multi-PI proposal by the conveners of the “Feb 2018 workshop with engineers”, this effort is anticipated to be led by Ting Lin.

b. Proposals that utilize a subset of simulations to analyze a specific structure and calculate responses are also encouraged: Several practicing engineers who attended our Feb and/or August workshops expressed interest in such a project.

c. Proposals focused on tall buildings, 2sec or longer fundamental periods.

d. Proposals that focus on preparing tools and protocols to facilitate access to simulated motions (possibly according to geographic bins) and appropriate selection of those motions for specific engineering applications: We have been talking about a multi-PI proposal for “Selection of simulated time-series for the MCER UGMS tool”, this effort will be led by Jack Baker. Other related proposals are welcome, but for anything related to UGMS/Cybershake simulations, PIs are encouraged to first coordinate with Jack.

3. Proposals related to validation exercises that are focused on new applications (e.g., bridges, tunnels, dams): Farzin Zareian presented a possible validation framework that could be used for any engineering application, interested PIs are encouraged to take a look at this framework before preparing their proposals.

Other ideas that were discussed and encouraged during the “Planning Workshop”:

4. Formalizing a collaborative effort with our international colleagues (e.g., Italy, New Zealand, Mexico)

5. Focusing on validations beyond median ground motion, and based on standard deviations and correlations

SCEC5 GMSV TAG Google Website
https://sites.google.com/view/scec5-gmsv-tag/home
(Summary of SCEC5 Projects, Meetings, and Outcomes)

Objective:
SCEC has established this TAG focused on GMSV in order to develop and implement, via collaboration between ground motion modelers and engineering users, testing/rating methodologies for simulated ground motions to be used in engineering applications.

Current Projects (SCEC5 Year1, 2017-2018):
- Continuation of the Ground Motion Simulation Validation (GMSV) TAG in SCEC5 (SCEC Award #17185). ***Sanaz Rezaeian, Jonathan Stewart***
- A MultiPI Project on Demonstrations of the Efficacy of the BBP Validation Gauntlets for Building Response Analysis Applications (started in SCEC4). ***Nico Luco et al.***
- Nonstationary ground motion spatial correlations in CyberShake simulations, and implications for regional risk analysis (SCEC Award #17058). ***Jack Baker***
- Selection of CyberShake Time Series for Engineering Building Code Analyses (SCEC Award #17056). ***Jack Baker***
- Physics-based scattering attenuation: Calibrating the correlation structure of a stochastic model for near-surface sediments in the Los Angeles basin (SCEC Award #17113). ***Domniki Asimaki***
- SDSU BBP Module Extension: Ground Motion Correlation, Duration, and Multi-Segment Ruptures (SCEC Award #17137). ***Kim Olsen***
- Implementing inter-period correlations into SCEC Broadband Platform simulations (SCEC Award #17138). ***Jeff Bayless, Paul Somerville, Andreas Skarlatoudis***
- Fourier-spectra based empirical site amplification modeling (SCEC Award #17149). ***Jeff Bayless, Paul Somerville, Andreas Skarlatoudis***
- Validation of the UCSB Multi-Segment Kinematic Rupture Simulation Method Against Recorded Ground Motion for Several Events (SCEC Award #17247). ***Ralph Archuleta, Jorge Crempien***
  (If you have a GMSV-related project that is not listed above please contact Sanaz at srezaeian@usgs.gov)

GMSV News & Events:

Next: November 13, 2018, Web-Conference:
Tuesday 4pm-5pm Pacific Time
Agenda:
- **4:00** Introductions
- **4:15** Jon Stewart (on a multi-PI proposal related to site response modules)
- **4:25** Ting Lin (on a multi-PI proposal related to engineering building response applications of SCEC simulations)
- **4:35** Sanaz Rezaeian (other potential proposals)
- **4:45** Discussion & Other Proposal Plans?
- **4:55** Adjourn

October 9, 2018, Web-Conference:
Tuesday 2pm-3pm Pacific Time
Agenda:
- **2:00** Introductions
- **2:10** An Overview of the Aug24 "Planning Workshop" (Rezaeian, 15min)
- **2:25** GMSV Objectives & Path Forward for "Engineering Applications" (Zareian, 10min)
- **2:35** "Key Take-Aways" from the Workshop (Stewart, 10min)

- **2:45** Questions & Discussion (10min)
- **2:55** Adjourn

Meeting Summary:

During this meeting, we reviewed our Aug24 "Planning Workshop" and discussed what types of GMSV-related proposals should be submitted in response to the SCEC RFP this year. Three research areas were discussed that are of interest to GMSV this year:

1. Proposals related to site response modules for the BBP: Jon Stewart mentioned that he is going to work on a proposal with Jeff Bayless, Andreas Skarlatoudis, and Domniki Assimaki on this topic. Other related proposals are welcome, but PIs are encouraged to collaborate with this group.

2. Proposals that encourage and/or enable engineering applications of SCEC simulations for response history analysis of buildings. Examples include:

a. Forming a committee to review prior GMSV work, vett through engineering practice committees (SEAOC seismology), identify gaps (as applicable), and prepare recommendations: We talked about a potential multi-PI proposal by the conveners of the "Feb 2018 workshop with engineers", this effort will be led by Ting Lin.

b. Proposals that utilize a subset of simulations to analyze a specific structure and calculate responses are also encouraged: Several practicing engineers who attended our Feb and/or August workshops expressed interest in such a proposal.

c. Proposals focused on tall buildings, 2sec or longer fundamental periods.

d. Proposals that focus on preparing tools and protocols to facilitate access to simulated motions (possibly according to geographic bins) and appropriate selection of those motions for specific engineering applications: We have been talking about a multi-PI proposal for "Selection of simulated time-series for the MCER UGMS tool", this effort will be led by Jack Baker. Other related proposals are welcome, but for anything related to UGMS/Cybershake simulations, PIs are encouraged to first coordinate with Jack.

3. Proposals related to validation exercises that are focused on new applications (e.g., bridges, tunnels, dams): Farzin Zareian presented a possible validation framework that could be used for any engineering application, interested PIs are encouraged to take a look at this framework before preparing their proposals

Other ideas that we did not focus on during our last conference call, but have come up in our previous meetings include:

4. Formalizing a collaborative effort with our international colleagues (e.g., Italy, New Zealand, Mexico)

5. Focusing on validations beyond median ground motion, and based on standard deviations and correlations

August 24, 2018, "Planning Workshop" at SCEC :

Website: https://www.scec.org/workshops/2018/gmsv-aug
Discussion Questions: https://docs.google.com/document/d/1jMoKdUzGe5SIXo-QVgfGnPLiVD9Tv3g27ATnIlbfF_w/edit?usp=sharing
Action Items: https://drive.google.com/open?id=1ba10eR-ZxXqVxXfXdTxxzhU9zD2wUqXp2Svgu37DWT4
Older Docs:
2018 SCEC GMSV TAG Proposal to hold this meeting/workshop: Proposal (summary presentation from Oct2017 call)
Acceptance Notice and feedback from SCEC (Received May 2018): Award#18161
Agenda & the full list of Invitees: https://drive.google.com/open?id=1MbPjM6fQM5FJZtX9aR-hjr_zkGVgXVHb

June 25, 2018, Participation of the GMSV TAG in the SCEC Workshop at 11NCEE:

Website: https://www.scec.org/workshops/2018/gms-engineering

June 22, 2018, Data Release:

A selected subset of simulated seismograms that were used in the February 2018 workshop with engineers were released as a product of the SCEC research project "Demonstration of the

Efficacy of the BBP Validation Gauntlets for Building Response Analysis Application". These files and supporting documents are posted on the workshop website: https://www.scec.org/workshops/2018/gmsv

June 6, 2018, Web-Conference
Wednesday 2pm-3pm Pacific Time
Agenda:

- **2:00** Introductions (*Sanaz Rezaeian*)
- **2:10** Hikurangi Subduction Interface Ground Shaking for Wellington, New Zealand *(Caroline Holden & Yoshi Kaneko)*
- **2:30** Updates on interactions with the engineering community (*Farzin Zareian*)
- **2:45** Update on the "2018 GMSV TAG Planning Workshop" *(Sanaz Rezaeian, Jon Stewart, Nico Luco)*
- **3:00** Adjourn

Participants:

1) Sanaz Rezaeian, 2) Nico Luco, 3) Caroline Holden, 4) Farzin Zareian, 5) John Vidale, 6) Greg Deierlein, 7) Paul Somerville, 8) Brendon Bradley, 9) Marco Stupazzini (participants interested but not able to attend: Jack Baker, Christine Goulet)

Meeting Notes:

- Caroline gave an interesting presentation on the simulations they are performing for large interface subduction earthquakes in Wellington region of New Zealand. John Vidale discussed that the conclusions were somewhat similar to the results of the M9 project in the Pacific Northwest of US. Caroline's group is planning to continue this work and look at the RZZ validation parameters for these simulations.
- Farzin gave a 10min oral update on his recent interactions with the engineers at SEAOSC and LA Tall Buildings meetings. 1) There is interest from SEAOSC community to get access to our "validated set of SCEC simulations". We discussed the timeline for the release of these simulations, we expect them to be posted for access by the engineering community before the 11NCEE conference, June 25 (the next SEAOSC meeting is June 20 and July 11). 2) There seems to be a misunderstanding by many engineers who think that SCEC simulations are equal to Cybershake, there should be better communication/education with engineers. 3) There seem to be an interest by the engineers to use simulations for "buried structures," such as pipelines and basically distributed infrastructures, where they need high frequency motions and need to account for spatial correlations.
- Sanaz briefly discussed a "Working Meeting" to plan future efforts of the GMSV TAG. We have news from SCEC that our proposal to hold this workshop has been accepted. We would like to hold this workshop either in late August at USC, or during the SCEC annual meeting at Palm Springs. more information is listed above under subheading "2018 SCEC GMSV TAG Proposal to hold a "Working Meeting" to plan our future efforts". Since this is a working meeting and likely held at the SCEC boardroom, we will have a small number of invitees, however, **if you would like to be involved in planning this Working Meeting (or to participate, remotely or in person)** please contact srezaeian@usgs.gov

Action Items:

- Start planning a Working Meeting for late August

April 25, 2018, Web-Conference
Wednesday 9am-10am Pacific Time
Agenda:

- **9:00** Introductions (*Sanaz Rezaeian*)
- **9:10** Selection of CyberShake Time Series for Engineering Building Code Analyses *(Jack Baker)*
- **9:30** Open Discussion: SEAOC Meeting Summary (*Farzin Zareian*), Update on the Vetted Set of Workshop Simulations (*Greg Deierlein, Ting Lin*)
- **10:00** Adjourn

Participants:

1) Sanaz Rezaeian, 2) Jon Stewart & Students, 3) Nico Luco, 4) Christine Goulet, 5) Farzin Zareian, 6) Greg Deierlein, 7) Kuanshi Zhong, 8) Nenad Bijelic, 9) Wen-Yi Yen, 10) Jack Baker,

11) Jeff Bayless, 12) Jae Park, 13) Kim Olsen & Students, 14) Fabio Silva, 15) Domniki Asimaki, 16) Marco Stupazzini (participants interested but not able to attend: Ting Lin, Caroline Holden)

Meeting Notes:

- There were great discussions on Jack's presentation about the vetted set of Cybershake simulations for engineers (11 ground motions for two sites LADT & PAS)
- Greg gave a short update on the status of vetted set of BBP (GP simulations) presented at the Feb workshop (12 sets of 11 ground motions each, this includes three sites LADT, SF & San Bernardino)
- Farzin's update on the recent SEAOC Meeting was postponed to the next webconference due to the limited time

Action Items:

- Same as Action Items from the March meeting

March 22, 2018, Web-Conference

Wednesday 10:30-11:30am Pacific Time

Agenda:

- **10:30** Introductions & workshop agenda (*Sanaz Rezaeian*)
- **10:40** A summary of "validation of SCEC seismogram simulations" *(Nico Luco)*
- **11:00** A summary of "Demonstrations of the use and validation of SCEC seismogram simulations for building response analysis" *(Ting Lin)*
- **11:20** Workshop outcomes *(Sanaz Rezaeian & All)*
- **11:30** Adjourn

Participants:

1) Sanaz Rezaeian, 2) Jon Stewart, 3) Nico Luco, 4) Ting Lin, 5) Farzin Zareian, 6) Kuanshi Zhong, 7) Nenad Bijelic, 8) Wen-Yi Yen, 9) Jack Baker, 10) Jeff Bayless, 11) Caroline Holden, 12) Leo Ramirez Guzman (participants interested but not able to attend: Christine Goulet, Rob Graves, Iunio Iervolino, Greg Deierlein)

Meeting Notes:

- Summarized the Feb 16 workshop and discussed the next steps
- Engineers were interested in validation of simulations but their primary interest was demonstration of how simulations can be used in practice --> our group may want to do more demonstration exercises (especially for different simulation approaches)
- Engineers were interested in a "vetted" set of simulations to be documented by Ting & Kuanshi and posted on the workshop website in the next month or so . The "vetted set" of simulations (11 time-series for 2 sites) that Jack Baker is working on might also be of interest to this group of engineers
- It was suggested to keep in touch with potential engineering users of simulations through other engineering events, one example is the special session at the 11NCEE that SCEC is organizing (SEAOC meetings were mentioned specifically along with the upcoming LA Tall Buildings meeting that Nico and Farzin are attending http://www.tallbuildings.org/)

Action Items:

- Keep in touch with the engineers: Once the vetted set of simulations are documented and posted, contact the engineers who attended the workshop and let them know of 1) the presentations and simulations that are available on the workshop website, and 2) the "follow-up" event at the 11NCEE organized by Christine Goulet
- Put Jack Baker in contact with SCEC to distribute his "vetted" set of simulations to the same group of engineers
- Write a SCEC report on the workshop: document the workshop through a conference paper (ICASP2019 conf paper was suggested as a good platform)

February 16, 2018, Workshop With Practicing Engineers

Earthquake ground motion simulations are one of the important products of SCEC. Convened by a subgroup of the GMSV TAG, this workshop aimed to connect scientists who create simulations with engineers who might use them in the future. The workshop objectives were to 1) engage potential engineering users of the SCEC simulations, 2) inform them of the latest developments in

ground motion simulation and validation, and 3) demonstrate the usefulness of simulated ground motions for building response analysis.
See the workshop website for summary, agenda, participants, and presentations:
https://www.scec.org/workshops/2018/gmsv

January 10, 2018, Web-Conference
Wednesday 10-11am Pacific Time
Agenda:
- **10:00** Introductions (*Sanaz Rezaeian*)
- **10:10** Implementing the inter-period correlation of epsilons in Exsim *(Jeff Bayless)*
- **10:30** SVM: A stochastic Sediment Velocity Model of the shallow crust based on geotechnical and geophysical data *(Jian Shi* on behalf of *Domniki Asimaki)*
- **10:50** Discuss the timing of future meetings *(All)*

Participants:
1) Sanaz Rezaeian, 2) Nico Luco, 3) Jon Stewart, 4) Ting Lin, 5) Farzin Zareian, 6) Jeff Bayless, 9) Jian Shi, 10) Paul Somerville, 11) Kim Olsen, 12) Jack Baker, 13) Kuanshi Zhong, 14) Philip Maechling, 15) Nenad Bijelic, 16) Fabio Silva

Meeting Notes:
- Discussed the importance of inter-period correlations in simulations (they are related to how noisy the response spectrum is and how wide the peaks and trusts are, which could effect variability in structural response) and Jeff's plans for their implementation in the BBP EXSIM (SMSIM) and GP high frequency simulations (already implemented for GP low frequency simulations). We discussed that these correlations are related to Fourier Spectrum, unlike Jack Baker's study that considers Response Spectrum, the assumption being that if FS correlations are good then RS correlations will also be good. How to validate/evaluate the results is to be addressed in future.
- Jian Shi talked about their Sediment Velocity Model (SVM), which is completed for 1D for shallow crust sediments (<Z1). Four datasets are merged in this model and the model is validated using existing models (CVM, GTL, etc). Questions were asked about the model being conditioned on Vs30, which comes from the Wills maps etc. Further discussed their plans to use 1D SVM to populate 2D and 3D spaces.
- Decided to hold future meetings on the 2nd or 3rd Wednesday of each month, take another poll to see if we should start at 10am or 11am.

November 14, 2017, Web-Conference
To talk about potential SCEC proposals for next year, Tuesday 4-5pm Pacific Time
Agenda:
- **4:00:** Introductions (*Sanaz Rezaeian*)
- **4:10:** *Potential Proposals (10min presentations & discussions)*
  Jon Stewart: on Validation of Cybershake simulations using observations of site effects from small-to-moderate magnitude earthquakes
  Jack Baker: on Spatial Correlation of ground motions in CyberShake simulations
  Ting Lin / Greg Deierlein: on Using Cybershake motions for estimating large structural deformations and collapse / relating intensity measures to fault features and basin effects
  Jeff Bayless: on Sensitivity of structural response to the variability of ground motion simulations
  Kim Olsen: on Incorporating spatial correlation and coherency in the SDSU BBP module.
  Sanaz Rezaeian: GMSV workshop at the SCEC Annual Meeting - focus on Cybershake
- **5:10:** Adjourn

Participants:
1) Sanaz Rezaeian, 2) Nico Luco, 3) Jon Stewart, 4) Ting Lin, 5) Farzin Zareian, 6) Christine Goulet, 7) Hoby Razafindrakoto, 8) Jeff Bayless, 9) Ruth Harris, 10) Kim Olsen, 11) Jack Baker

October 30, 2017, Web-Conference
The first SCEC5 GMSV TAG web-conference, Monday 2-3pm Pacific Time
Agenda:
- **2-2:10:** Introductions (*Sanaz Rezaeian*)

- **2:10-2:30:** Continuation of the Ground Motion Simulation Validation (GMSV) Technical Activity Group (TAG) in SCEC5 (*Jon Stewart)*
- **2:35-2:55:** A MultiPI Project on Demonstrations of the Efficacy of the BBP Validation Gauntlets for Building Response Analysis Applications (*Nico Luco*)

Participants:

1) Sanaz Rezaeian, 2) Nico Luco, 3) Jon Stewart, 4) Luis Dalguer, 5) Nenad Bijelic, 6) Peng Deng, 7) Andreas Skarlatoudis, 8) Phil Maechling, 9) Marco Stupazzini, 10) Greg Deierlein, 11) Ricardo Taborda. Ting Lin joined towards the end after her class. Jack Baker, Christine Goulet, Ralph Archuleta, Caroline Holden were not able to make it, although interested.

Meeting Notes:

- The next SCEC RFP is due in about a month, we need a coordinated set of proposals to address the two objectives of our TAG in the upcoming years: 1) validation for GMPEs (focusing on dispersion and correlation as well as the median predictions), 2) validation for specific engineering applications.
- It was suggested to explore external sources of funding to be able to conduct a more focused and impactful project, similar to what Dreger-Goulet project did with PG&E for median GMPEs.
- Luis brought up the possibility of joint international efforts.
- For our next web conferences, Jon suggested to hear from speakers who have explored validation for 3D simulations such as CyberShake simulations. Phil mentioned a reference to Graves & Goulet study/report. Greg, Ting and Nenad also have done some related work.

Link to previous (SCEC4) GMSV TAG wiki site:

http://collaborate.scec.org/gmsv/Main_Page