The SCEC Broadband Platform: Open-Source Software
for Strong Ground Motion Simulation and Validation

Fabio Silva, Philip J. Maechling, Christine A. Goulet, and Yehuda Ben-Zion
University of Southern California (silva, maechlin, cggoulet, benzion)@usc.edu

Broadband Platform 19.4 Overview
- Open-Source scientific software that can generate broadband (0-100Hz) ground motions
- Calculate ground motions at user specified sites for historical and scenario earthquakes
- Collaborative software development project involving:
  - SCEC Geoscientists
  - Civil Engineers
  - Graduate Students
  - SCEC Community Modeling Environment (CME)
- Integrates complex scientific modules including:
  - Rupture Generation
  - Site Effects Calculation
  - Seismogram Synthesis
  - Visualization
- Provides ground motion models from seven different research groups
- Integrates complex scientific modules including:
  - Collaborative software development project involving:
    - Calculate ground motions at user specified sites for historical and scenario earthquakes
    - Open-Source scientific software that can generate broadband (0-100Hz) ground motions
- Integrated RSQsim-generated rupture slip-time histories into BBP workflow
- Used in study of building response to strong ground motions
- Added Vs30-based site response module to simulation methods
- Migrated Broadband Platform from Python 2.7.x to Python 3.7
- Updated all simulation regions’ GFs and velocity models to use a Vs of 500m/s
- Included Central California, Central Italy, and Southern Walker Lane simulation regions
- Implemented multi-segment rupture capabilities into most BBP simulation methods
- Integrated new Irikura Recipe Method 2 simulation method into the Broadband Platform
- Ticketing system to document and resolve issues, documentation available on wiki

Good Software Engineering Practices
- Formal software releases
- Unit tests verifies that modules are working properly
- Common input/output data formats allows for interchangeable modules
- Automated software testing process
- Modular architecture
- Ranking of PSA period GoF for all realizations
- Combine data from multiple realizations

Scenario Simulations
- Calculate seismograms of a hypothetical earthquake
- User provides event description
- Earthquake location
- Magnitude and Mechanism
- Use sites specified by the user
- 1D Green’s Functions Available
- California (4), Japan (2)

Simulation Methodologies
- Stochastic Method: EXSIM (UWO)
- Broadband Using 1D Green’s Functions: UCSB, Composite Source Model (CSM)
- Hybrid - Green’s Functions LF, Stochastic HF: Gravés & Pitarak (GP), SDSU, SONG, Irikura Recipe Methods 1 and 2

Good Software Engineering Practices
- Modular architecture
  - Supports code integration from multiple sources with minimal changes to original code
  - Common input/output data formats allows for interchangeable modules
- Automated software testing process
  - Unit tests verifies that modules are working properly
  - End-to-end acceptance tests confirm user installation produces expected results
- Formal software releases
  - Version control to track software changes and versions using GitHub
  - Ticketing system to document and resolve issues, documentation available on wiki

Recent Broadband Platform Developments for 2018–2020
- Integrated new Irikura Recipe Method 2 simulation method into the Broadband Platform
- Implemented multi-segment rupture capabilities into most BBP simulation methods
- Included Central California, Central Italy, and Southern Walker Lane simulation regions
- Updated all simulation regions’ GFs and velocity models to use a Vs of 500m/s
- Added Parkfield, San Simeon, Iwate, Chuetsu-Oki, and L’Aquila as new validation events
- Migrated Broadband Platform from Python 2.7.x to Python 3.7
- Added Vs30-based site response module to simulation methods
  - Correction of observations to rock site levels is no longer used in validation simulations
- Used to simulate ground motions produced by large magnitude (M7.5+) ruptures
- In study of building response to strong ground motions
- Integrated RSQsim-generated rupture slip-time histories into BBP workflow
  - Used to calculate large collection of ground motion parameters for M6 to M8 ruptures

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BBP 19.4 available for download at https://github.com/SCECcode/bbp