



***A NEW SPECTRUM MATCHING-
RESPONSE SPECTRUM IN CENTRAL
UNITED STATES***

Agency Tracking # 40100-16016
Edison ID – 47830
MSA #: RES2016-24

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PURPOSE OF THE PROJECT

Improve site-specific seismic loading definition in West TN where little strong motion data of significance is available. The objective of this research is to develop a new frequency-domain spectrum matching using recordings of small earthquake by generating broadband seismograms for large magnitudes target earthquake in West Tennessee.

SCOPE AND SIGNIFICANCE OF THE PROJECT

The scope of the proposed work include:

Application of the new frequency-domain spectrum-matching process to develop a suit of acceleration time histories whose characteristics reasonably represent the ground motions expected for the sites in Central and Eastern United States (CEUS) requires eight steps:

- 1) Select suitable actual EGFs and/or interpolate EGFs performed by correcting for geometrical spreading, crustal Q-factor, and kappa for regions where the small-magnitude events are limited;
- 2) Develop low-frequency simulated ground motions using a frequency-wavenumber integration method;
- 3) Merge the low-frequency simulated time histories with the high-frequency EGFs to provide broadband ground-motion time histories for CEUS;
- 4) Calculate the generation of realistic acceleration time histories for large-magnitude events using time delay-stochastic summation of EGFs;
- 5) Process the generated acceleration time histories for the target earthquakes with moment magnitudes ranging from 5.5 to 8.0 located at distances up to 1000 km from earthquakes.
- 6) Develop new spectrum-matching in frequency domain using EGFs and new frequency-domain baseline correction for CEUS; The spectrum matching procedure will use a target spectrum. The target spectrum can be the Uniform Hazard Response Spectrum (UHRS), conditional mean target spectrum (CMS), or code based response spectrum. The user will select the target spectrum for matching purposes.
- 7) Comparison of results with other spectrum-matching processes for CEUS. The acceleration, velocity and displacement time histories are examined to ensure that they are reasonably close to the original or target values in terms of peak values, wave forms, strong shaking duration, and other critical features such as the near-fault velocity pulse (e.g., fling and directivity effects); and
- 8) Power spectral density (PSD) functions are examined to ensure a broad distribution of energy in the final spectrum-compatible motion as a function of the Fourier period.

EXPECTING OUTCOMES

Currently, there are limited moderate and large ground motions in Central United States. This research will be another step towards application of a new frequency-domain spectrum matching process to develop a suit of acceleration time histories whose characteristics will represent the ground motions expected for the sites in West Tennessee. Frequency-domain spectrum-matching procedure to generate matched time histories would be the deliverable, along with a report and a user's manual.

TIME PERIODS AND STATUS OF THE PROJECT

The project started on October 1, 2015. The work on the project is progressing on schedule. We are making good progress. One Ph.D. student (Farhad Sedaghati) is currently working on this project.

The total project duration will be 24 months (October 1, 2015 – March 31, 2018). A final report documenting the research results will be submitted. Dr. Pezeshk is responsible for all aspects of this project. Dr. Pezeshk will work with Dr. Tim Huff closely for all aspects of this project. A tentative schedule and time periods for accomplishing tasks of this project are provided in Table 1.

Table 1. Schedule

Tasks	October 1, 2015 – September 30, 2017							
	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8
Task 1: Selection of EGFs								
Task 2: Develop low-frequency simulated ground motions								
Task 3: Provide broadband EGFs								
Task 4: Time delay-stochastic summation of EGFs								
Task 5: Develop new spectrum-matching in frequency domain using EGFS								
Task 6: Comparison of results with other spectrum-matching processes								
Final report								