PEER Blind Prediction Contest of Shaking Table Tests for the Seismic Response of a Rocking Podium Structure

The objective of this contest is to predict the maximum bi-directional seismic response of a four-column rocking podium structure excited by artificially generated ground motions applied by a shaking table.

1. Information and details regarding the rocking podium structure, applied motions, and the acquired data can be found at the following web site: https://peer.berkeley.edu/news-and-events/2019-blind-prediction-contest/ . The rocking podium structure was designed by the ETH Zurich team led by Prof. Michalis Vassiliou. Structural drawings are provided in SI units. A sample test video and description of the rocking podium structure construction sequence, supported with photographs, are also provided. The tests were conducted using the 6-dof shaking table located at the Earthquake and Large Structures (EQUALS) Laboratory of the University of Bristol. The data was acquired using an optical measurement system and tracking targets positioned on the specimen and the shaking table top surfaces, both considered as rigid. The sampling rate was 5000Hz. The acquired data was filtered using a low-pass 8-pole Butterworth filter with a cut-off frequency set at 1400 Hz.
2. Contestants are expected to predict the responses for a total of 200 motions. Files ug1.txt-ug100.txt correspond to tests EC1-EC100 (EC: El Centro), while files ug101.txt-ug200.txt correspond to tests CC1-CC100 (CC: Chi-Chi). These files contain the acceleration time histories in the x, y and z direction (as shown in the structural drawings) measured on the shaking table surface in units of g. Each file has 225000 x-y-z entries, with dt =0.0002 sec, covering 45 seconds from the beginning to the end of each test.
3. The contestants must use the contest submittal spreadsheet *Contestantsubmittalspreadsheet.xls* to submit their results. In this file, they must provide their prediction of the following parameter for each of the 200 conducted tests (EC1-EC100, CC1-CC100):

$$\text{Mave} = \max_{t}\left[abs\left(\frac{\text{M1(t)} + \text{M3(t)} + \text{M4(t)} + \text{M6(t)}}{4}\right)\right]$$

where M1, M3, M4, and M6 are displacements of the points marked in Figure 1 in the horizontal (x-y) plane, with respect to the shaking table surface in millimeters, rounded to the first digit beyond the decimal point. These points correspond to the vertical projection of each column center to the top surface of the podium slab.

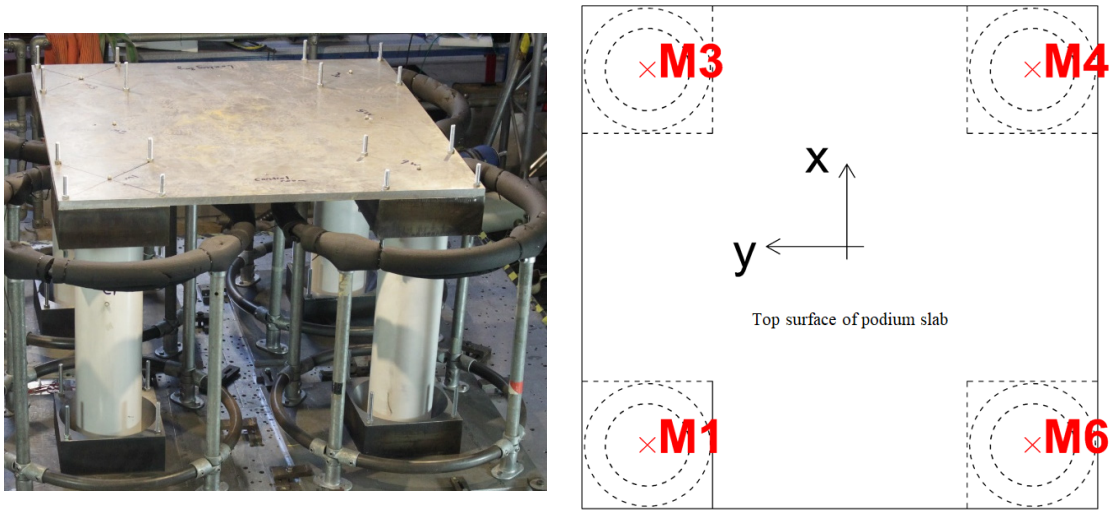

Figure 1. Specimen with markers for displacement measurements.

4. Along with the predictions, contestants should submit a technical report of 5-20 pages electronically as a pdf document in ASCE journal format. Contents of the report may include text, figures and tables that describe the model, utilized software platform, materials, elements, solution algorithms, assumptions, discussion of the analysis results, and summary of key results beyond those in the spreadsheet. ASCE Journal format can be downloaded from the Submission Format tab. Contestants may be of individuals or teams.
5. The following system, based on Bachmann et al. (2018)[1] will be used to determine the winning submission:

   An Empirical Cumulative Distribution Function (CDF) will be plotted based on the submitted 100 Mave values for the EC1-EC100 test series. The Empirical CDF of Mave is defined as follows: For a value t in Mave, the Empirical CDF F(t) is the proportion of the values in Mave less than or equal to t. For the construction of the Empirical CDF, the cdfplot Matlab function will be used. More info can be found in https://www.mathworks.com/help/stats/cdfplot.html.

   An Empirical CDF will also be plotted for the recorded data from the tests. The error for the El Centro (EC) test series *ErrEC* will be computed as the absolute value of the maximum vertical distance between the submitted data CDF and the measured data CDF, also known as the Kolmogorov-Smirnov Distance (Figure 2). The distance will be measured based on the stair-like plot generated by the Matlab cdfplot function. In case the contestants choose to submit results for less than 100 ground motions, we will construct an empirical CDF plot based on the data that we receive. That is, if a team submits results for 50 ground motions, the CDF will be plotted for these 50 ground motions only and will contain not 100 but 50 data points.

   The same procedure will be repeated to compute error *ErrCC* for the CC1-CC100 test series.

[1] Bachmann, J. A., Strand, M., Vassiliou, M. F., Broccardo, M., & Stojadinović, B. (2018). Is rocking motion predictable?. *Earthquake Engineering & Structural Dynamics*, 47(2), 535-552, DOI: 10.1002/eqe.2978

The total error will be computed as the sum *ErrEC* + *ErrCC*. The team with the smallest total error will be declared the winner.

It is noted that the contestants do not need to submit CDF plots, but only the Mave vector (max 100 values for EC and 100 values for CC). CDFs will be constructed by the blind prediction competition organizing committee, based on the procedure described above.

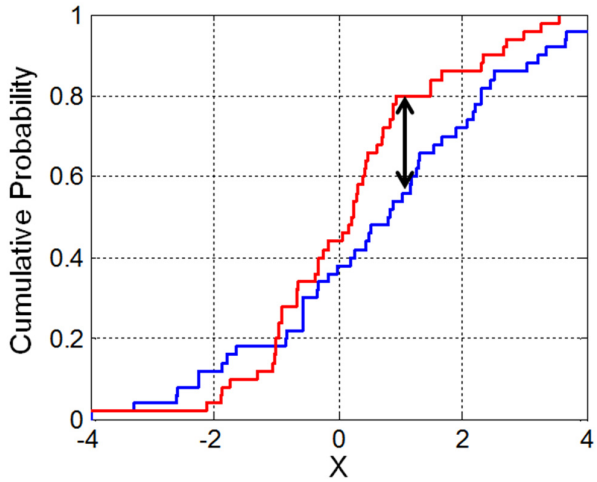

Figure 2. Demonstration of the Kolmogorov-Smirnov distance

6. A representative of the winning team will be invited to the 2020 PEER Annual Meeting that will be held on the UC-Berkeley campus, January 16-17, 2020, with reasonable amount of travel expenses covered. The representative will be asked to make a short presentation on the techniques used (model and analysis) in making the winning predictions. Awards will be presented in a special session at this event.
7. One individual may only be involved in one single submission. If an individual is part of a team, that individual cannot participate in the competition separately as an individual.
8. Contestants from ETH Zurich, University of Bristol and the University of California Berkeley, involved in the conduct of the tests and organization of the competition are not allowed to participate.
9. Contestants should submit their results before November 20, 2019. Winners will be notified by November 27, 2019. Except for the winners, all submittals will be kept anonymous.
10. Questions about the blind prediction contest or details of the structure or input motions can be submitted to (e-mail address: peer_center@berkeley.edu) until November 12, 2019. Questions and answers will be posted on the web site https://peer.berkeley.edu/news-and-events/2019-blind-prediction-contest/ under the *Q&A* tab and will be updated twice per week.