STABILITY ASSESSMENT OF THE GMPES FOR IRANIAN GROUND MOTION DATABASE

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Selection of Ground Motion Prediction Equation (GMPE) is one of the key elements within a seismic hazard analysis. The variety of available GMPE models makes this selection a scientific challenge. Therefore, the stability assessment of a set of GMPE models are investigated in this paper by employing the new emerged Re-Sampling Analysis (RSA) methodology (Azarbakht et al., 2014).

Four GMPE categories were examined in this paper which are: (1) The local GMPE models which are developed based on Iranian events, (2) Regional GMPE models which are for Europe and Asia, (3) The NGA-WEST1 GMPE models (Power et al., 2008), and (4) The NGA-WEST2 GMPE models (Bozorgnia et al. 2014). The ground motion database in this study consists of 691 acceleration time series resulted from 85 seismic events. The magnitude range is between 5.0 to 7.4 and all the records have the distance less than 200 km (BHRC, 2013).

The RSA results are shown in Figures 1 to 3 in which illustrate the bias versus the magnitude, distance measure (Joyner-Boore distance (R_{JB}) is identical to Epicentral distance (R_{epi}) in this study) and shear wave velocity (Vs30). The left figures (a) are belonged to the NGA-WEST1 models, the right figures (c) are based on the NGA-WEST2 models and the middle figures (b) are based on the four local and regional GMPE models.

It is worth to mention that, with respect to the RSA methodology, an unbiased model should represent an ascending performance while the sample size is increased. In other words, as the subset gets more data, the less bias should be observed.

By given the mentioned points, as seen in Figures 1 to 3, Rahpeyma et al. (2014) model, a genetic programming based (GP-based) GMPE, as well as Zafarani et al (2012), physical attenuation relationship, shows good agreement against different seismic parameters (Mw, R_{JB}, Vs30) with this criteria. In addition, both NGA GMPE groups (NGA-WEST1 and NGA-WEST2) show poor performance based on the RSA results.

A more detailed look at Figures 1 to 3 reveals that among NGA-West1 and NGA-West2 GMPEs, although BA08 and BA14 have ascending trend toward Mw, they are completely biased against R_{JB} and Vs30. Moreover, AS08 and CB14 display good compatibility with the Iranian data set only in the case of R_{JB} and Vs30, respectively. On the other hand, among regional and local GMPEs, KG04 model is heavily biased versus Mw and R_{JB} with descending trend through different subsets of Iranian database. Additionally, AC10 model has poor performance toward all seismic parameters and is totally biased.

Finally, it should be remembered that RSA method can be applied not only for assessing the stability of different GMPEs towards various seismic parameters but also it can be used as a visual test for a multitude number of statistical indices.

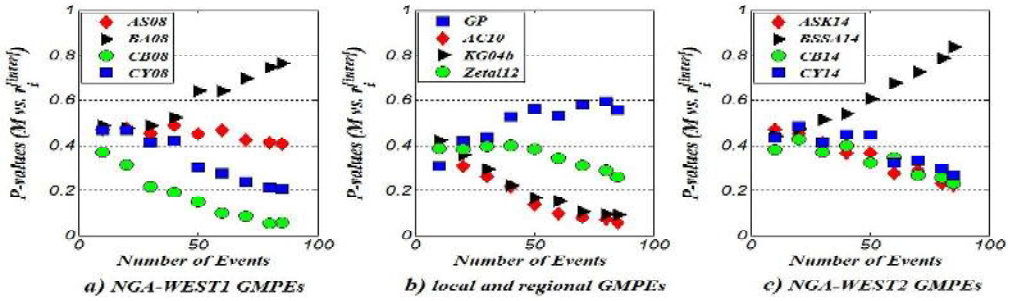

Figure 1. Median-RSA of inter-event residuals v.s. Mw for 400 uniform random selected databases

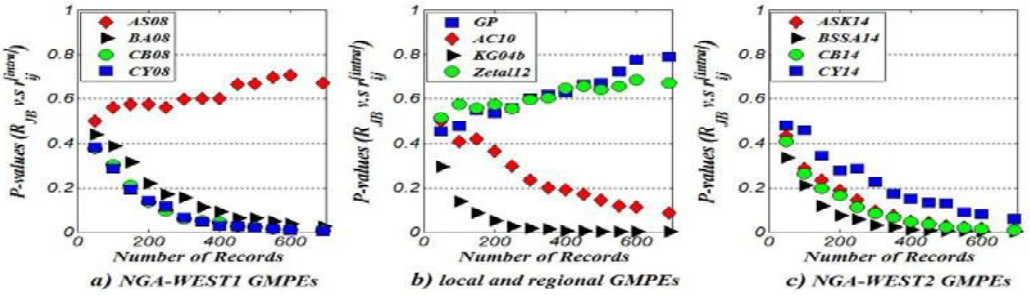

Figure 2. Median-RSA of intra-event residuals v.s. RJB for 400 uniform random selected databases

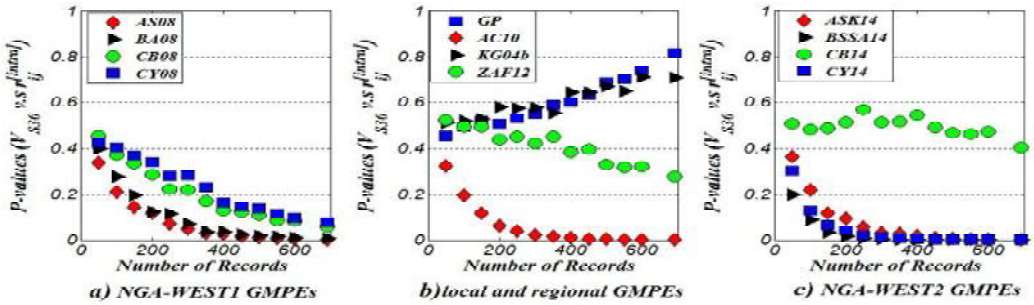

Figure 3. Median-RSA of intra-event residuals v.s. V_{S30} for 400 uniform random selected databases

REFERENCES

Azarbakht A, Rahpeyma S and Mousavi M (2014) A New Methodology for Assessment of the Stability of Ground-Motion Prediction Equations, *Bulletin of the Seismological Society of America*, 104(3), doi:10.1785/0120130212

Bozorgnia Y, Abrahamson N A, Atik L A, Ancheta T D, Atkinson G M, Baker J W, Baltay A, Boore D M, Campbell K W, Chiou B S-J, Darragh R, Day S, Donahue J, Graves R W, Gregor N, Hanks T, Idriss I M, Kamai R, Kishida T, Kottke A, Mahin S A, Rezaeian S, Rowshandel B, Seyhan E, Shahi S, Shantz T, Silva W, Spudich P, Stewart JP, Watson-Lamprey J, Wooddell K and Youngs R (2014) NGA-West2 research project, *Journal of Earthquake Spectra*, doi: 10.1193/072113

Building and Housing Research Center (BHRC) Available from http://www.bhrc.ac.ir/portal/, (May 2013)

Power M, Chiou B, Abrahamson N, Bozorgnia Y, Shantz T and Roblee C (2008) An overview of the NGA project, *Journal of Earthquake Spectra*, *24*(1): 3-21

Rahpeyma S, Azarbakht A and Mousavi M (2013) A new Peak-Ground-Acceleration prediction model by using genetic optimization techniques for Iran´s plateau database, *Journal of Seismology and Earthquake Engineering*, 15(3): 153-170