Prediction of Peak Ground Acceleration by the Genetic Programming

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***Abstract*—** Peak ground acceleration (PGA) has still been considered one of the important factor that plays the significant role on the earthquake-induced damage of structures. Thus, prediction of the PGA and selection of appropriate ground motion models often have become a valuable topic for seismic hazard assessments. With using some strong ground motion from Iran prediction of GPA by applying Genetic Programming is scrutinized in this study. The proposed GP models are based on the most reliable database compiled for earthquakes in Silakhor Plain, Lorestan, Iran. In GP modeling processes, Frequency and the earthquake source to site distance are considered as inputs and PGA values as the output consequently. The results show that, the obtained results represent the appropriate performance genetic programming in the estimation of the PGA and the consistency between the observed PGA values and the predicted ones by the GP models yield relatively high correlation coefficients (R=0.80).

***Keywords*—** attenuation relationships**,** earthquake engineering, genetic programming, PGA, strong ground motion parameters

1- Introduction and Literature view

Having a realistic seismic hazard assessment would be needed to mitigate economic and social damages lead in earthquakes. Hence, taking appropriate ground-motion especially the PGA is needed for having such estimation of. It also eclipses the design os structures. [16], [10]. Tow ways in which seismic hazard assessment are deterministically and probabillistically [11]. Both of these approaches need attenuation models for ground motions, which are developed by regression analysis of strong motion database. The prediction of the expected strong ground motion, such as PGA and its intrinsic variability at a particular site for earthquake sources with given characteristics is an important factor that is most sensitive to seismic hazard. Hence, seismic hazard analysts are frequently confronted with the difficult question of selecting appropriate formulations to be practiced in the target region [8]. PGA is conventionally estimated from strong ground motion attenuation equations, and the state of practice for development of attenuation relation is to establish a mathematical model between the dependent and independent variables of the ground motion through regression analysis [19], [10]. Application of the regression method can produce some problems due to inhomogeneity in terms of independent parameters of most strong ground motion sets. There are some idealization of complex processes faults and estimation drawbacks with prevalently utilized regression For highly non-linear forms of the regression, where a small change in one coefficient strongly affects another coefficient's value, special techniques need to be employed [7], [10].

A number of reviews of ground-motion prediction equations (GMPEs) have been created in the past that, provide a full summary of the methods employed, the results obtained and the troubles connected with such relations. Refrence number [2] provided an overview of relations that are used for seismic design in Europe, although they did not offer details about the methods utilized. Recent reviews include those by Refrence number [5], which provide the coefficients for some frequently-used PGA equations. Refrence number [4] discussed some pressing problems in the field of empirical ground-motion estimation. In the past couple of years, data deriving modeling by artificial intelligence techniques, such as GP and artificial neural networks (ANNs) supplied a different approach to estimate the ground-motion characteristics. Such methods cause a great capability of adaptively learning from experience and extracting various discriminators. Refrence number [17] employed artificial neural network (ANNs) to predict PGA at two main line sections of Kaohsiung mass rapid transit in Taiwan. A major constraint on the application of ANN is the network's tendency to become trapped in local minima [14]. To manage with this problem and to hold an optimal solution, a neural network may be trained using global search algorithms such as genetic algorithms [20], [22]. The basic disadvantage of this method was its linearity. Afterwards that, artificial neural network technique introduced. The effects of these new relationships obtained by the artificial neural network technique were somewhat nearer to the real values. But the disadvantage of this method was that the answers were based on weight matrices.

A new soft computing technique, GP, which is a promising tool for identifying key variables of functions within the genetic approaches such as genetic algorithm (GA) [18]. The GP model allows developing spatially a model for solving

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