Chapter 6
Determination of Spatial Variability of Rock Depth of Chennai

Pijush Samui
National Institute of Technology Patna, India

Viswanathan R.
Galgotias University, India

Jagan J.
VIT University, India

Pradeep U. Kurup
University of Massachusetts – Lowell, USA

ABSTRACT

This study adopts four modeling techniques Ordinary Kriging(OK), Generalized Regression Neural Network (GRNN), Genetic Programming(GP) and Minimax Probability Machine Regression(MPMR) for prediction of rock depth(d) at Chennai(India). Latitude (L_x) and Longitude(L_y) have been used as inputs of the models. A semivariogram has been constructed for developing the OK model. The developed GP gives equation for prediction of d at any point in Chennai. A comparison of four modeling techniques has been carried out. The performance of MPMR is slightly better than the other models. The developed models give the spatial variability of rock depth at Chennai.

INTRODUCTION

Rock depth (d) is an important parameter for any civil engineering project. The determination of rock depth has direct influence in the construction and mining works. Hence, the prediction of d is an important task in civil engineering. There are various direct methods for the determination of rock depth, which is not economical. The rock depth has the direct influence on segregating the seismic site. The classifica-

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tions on seismic sites are utilized for estimation of response spectral ordinates at the surface of the soil (Anabazhagan et al., 2013). Magnetic and resistivity geophysical methods were used to investigate the location and depth of mineral rock, which is also the most expensive methods. This article uses Ordinary Kriging (OK), Generalized Regression Neural Network (GRNN), Genetic Programming (GP) and Minimax Probability Machine Regression (MPMR) for prediction of d at any point in Chennai (India). The latitude and longitude of Chennai are 13.08°N and 90.27°E respectively. The database contains information about Latitude (L_x), Longitude(L_y) and d at 67 different points of Chennai. A comparative study has been carried out between the developed OK, GRNN, GP and MPMR models.

BACKGROUND

Researchers used various random field method for prediction purpose (Yaglom, 1962; Lumb, 1975; Alonso & Krizek, 1975; Vanmarcke, 1977; Tang, 1979; Wu &Wong, 1981; Tabb & Yong, 1981; Asaoka & Grivas, 1982; VanMarcke, 1998; Baecher, 1984; Baker, 1984; Kulatilake & Miller, 1987; Kulatilake, 1989; Fenton, 1998; Phoon & Kulhawy, 1999; Fenton, 1999; Uzielli et al., 2005). In random field method, the science of prediction in the presence of correlation between samples is not at all well developed. Statistical parameters contain uncertainty in random field method. In order to fill the holes of some uncertainty and also to reduce the cost, various intelligent techniques were evolved and utilized according to the requirements.

OK is an interpolation technique (Matheron, 1963; Isaaks & Srivastava, 1989; Davis, 2002). It uses semivariogram for prediction. This technique paved its efficiency in making the super-resolution of an image. Zhang and Wu (2015) had proposed this approach to yield adaptive weight and edge preservation. Dai et al., (2014) has applied OK for the spatial prediction of soil organic matter content in the Tibetan Plateau. There are lots of applications of OK in the literatures (Eldeiry & Garcia, 2012; Clough & Green, 2013; Emadi & Baghernejad, 2014). GRNN is proposed by Specht (1991). It approximates any arbitrary function between the input and output variables. The landslide is one of the major disasters with the worse effects in soil displacement. Jiang & Jiejie (2016) has successfully utilized the GRNN for the prediction of displacement of landslides by incorporating the K-fold cross validation. In the stream of materials engineering, the microstructural studies has great issues. Ozturk & Turan (2012) has adopted GRNN for forecasting the effects of microstructural phases of cement mortaer when it was added with the admixtures. Gaurav & Hasmat (2016) predicted the velocity of wind for the Western region of India by the utilization of GRNN. Many other applications of GRNN are available in the literatures (Kaveh et al., 2012; Singh & Murthy, 2013; Ding et al., 2014). GP is developed based on the concept of genetic algorithm. In order to forecast the flyrock distance, GP was effectively utilized and the effective equations were produced (Roohollah, et al., 2016). Also, GP was employed to predict the stability number of armor blocks due to the rubble-mound breakwaters. The efficiency of this model has outperformed the Van der Meer's stability equations (Mehmet et al., 2016). Researchers use GP for solving many problems (Huang et al., 2012; Danandeh et al., 2013; Zahiri & Azamathulla, 2014). MPMR is developed based on Minimax Probability Machine Classification (Lanckriet et al., 2002). MPMR was resulted as the effective model for forcasting the wireless network traffic in a specific network (Kong et al, 2009). It has been successfully applied to model different problems (Yu et al., 2012; Zhou et al., 2013; Yang & Ju, 2014). These intelligence techniques have successfully employed in various complex problems.