APPLICATION OF GMDH-TYPE NEURAL NETWORK FOR PATH LOSS PREDICTIONS

Usman A. U., Aliyu Ozovehe
Department of Electrical and Electronics Engineering,
Federal University of Technology, Minna, Nigeria, +2348065475430
Department of Information and Communication Technology,
Usmanu Danfodiyo University, Sokoto, Nigeria

usman.abraham@futminna.edu.ng and aliyu123oz@gmail.com

ABSTRACT

This paper proposes the use of Group Method of Data Handling (GMDH) technique for Path Loss Prediction as a non-linear function approximation in Cellular mobile network propagation losses. The paper compared prediction accuracy of GMDH with adaptive neuro-fuzzy inference systems (ANFIS) using four statistical performance indices with actual signal strength measurement taken at certain suburban areas of Bauchi metropolis, Nigeria. The proposed GMDH model was found to offer improved prediction results in terms of reducing the root mean square error (RMSE) and mean absolute error by 33.26% and 21.86% respectively over the ANFIS model.

Keywords: Group Method of Data Handling; Adaptive Neuro-Fuzzy Inference Systems; Path Loss; Polynomial Classifier, Propagation Loss and Signal Strength

1.0 INTRODUCTION

Path loss prediction modeling is crucial for analyzing existing and designing a new propagation path between transmitters and receivers in radio communication network in order to obtain an accurate model for radio propagation losses. However, it is difficult to have an explicit mathematical expression for path loss modeling due to diffraction, scattering, reflection, refraction and attenuation phenomena that characterized radio propagation paths. Hence, the use of pattern recognition predictive techniques based on input and output that are terrain specific came as a viable alternative for path loss modeling [1].

Various techniques for modeling path loss based on pattern recognition and multivariate regression have been reported in the literature. Artificial neural networks [2-3], neuro-fuzzy systems [2, 4, 5], and polynomial classifiers [6] are examples of such techniques. In general, these techniques use learning paradigms to estimate the path loss phenomena. As such, the modeling of nonlinear systems of high order like path loss requires large amount of input and output patterns for accurate modeling and identification of terrain specific information. The work of [2] made use of a first order Takagi-Sugeno-Kang (TSK) that has five layers, inputs, x and y and an output $f(x, y)$ as shown in Figure 1.