A Neural Smith Chart

M. Fatih ÇAĞLAR [(1)], Filiz GÜNEŞ [(2)]
(1) Süleyman Demirel University, Department of Electronics and Communication Engineering, Isparta, Turkey, +90 246 211 13 91
mfcaglar@mmf.sdu.edu.tr
(2) Yıldız Technical University, Department of Electronics and Communication Engineering, Beşiktaş- Istanbul, Turkey, +90 212 259 70 70-2881
gunes @yildiz.edu.tr

Abstract

The manual analysis and design of microwave circuits are generally tedious and error prone. The Smith chart provides a very useful graphical tool to these problems. A great deal of knowledge can be acquired from a Smith chart e.g. standing wave ratio, single and double stub tunings and much more. The Smith chart is very useful in conveying input impedance variations along a transmission line as the observation point moves away from the load. Although Smith charts valuable an contain significant amount of information in accurate observations can lead to erroneous results and frustration. In this work, an artificial neural network (ANN) model of the Smith chart is achieved. In this model, the two bilinear transformations between the rectangular Z(Y)-plane and the reflection coefficient Γ-plane are employed in both directions for the training data. Furthermore, translation of the reflection coefficient along the lossless line from the load is also used. In the current work, the feedforward Multilayer Perceptron (MLP) type of neural network is utilized with the two hidden layers, five inputs and two outputs. Real and imaginary part of load impedance, physical length and characteristic impedance of the transmission line, operation frequency are inputted to this network, while the magnitude and the phase of the input reflection coefficient are taken as the outputs. Each of the hidden layers has the eighteen neurons activated by the hyperbolic tangent sigmoid function. The output neurons are linearly activated, also. Great generalization ability of the neural networks results in very good accuracy. Input impedance variations along the transmission line are given as a typical example for the utilization of the Neural Smith chart. Furthermore, Neural Smith chart can be employed Neural Unit Element (NUE) and Neural Stub Element (NSE) to be used in microwave circuitry.