Modeling Of BJT With Fuzzy System And ANFIS

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Abstract

The ability of ANFIS will be follow various curves of the bipolar transistor and comparing with self defined Fuzzy Systems. The results show worse diagnostic than self-defined fuzzy if the input data has higher dispersion. Another achievement show two things:
1- Self defined fuzzy modeling is more powerful while we don't want to involve with more rules
2-ANIFIS just in the condition which very higher number of rules and in the same time higher number of training data suggests more accurate model considering that the reason of being less of our training data is because of that we aware of relations between data.

Introduction

A bipolar junction transistor (BJT) is a three-terminal electronic device constructed of doped semiconductor material and may be used in amplifying or switching applications**.** Bipolar transistors are so named because their operation involves both electrons and holes. Charge flow in a BJT is due to bidirectional diffusion of charge carriers across a junction between two regions of different charge concentrations. By design, most of the BJT collector current is due to the flow of charges injected from a high-concentration emitter into the base where they are minority carriers that diffuse toward the collector, and so BJTs are classified as minority-carrier devices.

A BJT consists of three differently doped semiconductor regions, the emitter region, the base region and the collector region.These regions are, respectively, p type, n type and p type in a PNP, and n type, p type and n type in a NPN transistor. Each semiconductor region is connected to a terminal, appropriately labeled: emitter (E), base (B) and collector (C).The base is physically located between the emitter and the collector and is made from lightly doped, high resistivity material. The collector surrounds the emitter region, making it almost impossible for the electrons injected into the base region to escape being collected, thus making the resulting value of α very close to unity, and so, giving the transistor a large β. A cross section view of a BJT indicates that the collector–base junction has a much larger area than the emitter–base junction. The transistors, is usually not a symmetrical device. This means that interchanging the collector and the emitter makes the transistor leave the forward active mode and start to operate in reverse mode. Because the transistor's internal structure is usually optimized for forward-mode operation, interchanging the collector and the emitter makes the values of α and β in reverse operation much smaller than those in forward operation; often the α of the reverse mode is lower than 0.5. The lack of symmetry is primarily due to the doping ratios of the emitter and the collector. The emitter is heavily doped, while the collector is lightly doped, allowing a large reverse bias voltage to be applied before the collector–base junction breaks down. The collector–base junction is reverse biased in normal operation. The reason the emitter is heavily doped is to increase the emitter injection efficiency: the ratio of carriers injected by the emitter to those injected by the base. For high current gain, most of the carriers injected into the emitter–base junction must come from the emitter.

Literature work and review

The problem of Bipolar Transistor Modeling with Fuzzy Systems and ANFIS in this BJTs are classified as minority-carrier devices . Semiconductor transistor terminal appropriately labeled emitter (E), base (B) and collector (C) . The emitter–base junction the collector–base junction breaks down the carriers injected into the emitter–base junction must come from the emitter various parts were doped to make them into semiconductors, etc . how the device responds to changes in the applied voltages and currents. Base-Emitter junction this voltage/current characteristic curve has an exponential-like shape similar to that of a normal PN Junction diode a bit from device to device and with the temperature quickly draw over to the Collector any free electrons which enter the Base region from the Emitter . Bipolar Transistors as it contains quite a lot of detailed information change either the base current or the applied Collector potential ; the Base and Emitter it eventually stops drawing any electrons out of the device and the Collector current falls towards zero . This system contains two inputs namely x and y and an output or Z which is associated with the following rules .This layer is the last layer of the network and is composed of one node and adds up all inputs of the node.

Propose work

ANFIS uses two neural network and fuzzy logic approaches. When these two systems are combined, they may qualitatively and quantitatively achieve an appropriate result that will include either fuzzy intellect or calculative abilities of neural network. As other fuzzy systems the ANFIS rules. We may recognize five distinct layers in the structure of ANFIS network which makes it as a multi-layer network. A kind of this network, which is a Sugeno type fuzzy system with two inputs and one output, is indicated in Figure1 . As shown in Figure1, this system contains two inputs namely x and y and an output or Z which is associated with the following rules .

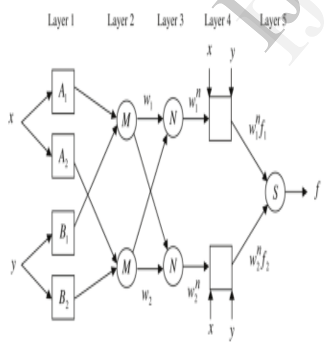

Figure 1

Rule 1 If (x is A1) and (y is B1) then Z1=p
Rule 2 If (x is A2) and (y is B2) then Z2=p1
In this system, Ai, Bi and Zi2x+qx+q12y+ry+r12 are fuzzy sets and system's output respectively. pi , qi and r are designing parameters which are obtained during the learning process. Then we may explain the various layers functions of this network as follows:

Layer 1: In this layer, each node is equal to a fuzzy set and output of a node in the respective fuzzy set is equal to the input variable membership grade. The parameters of each node determine the membership function form in the fuzzy set of that node.

Layer 2: In this layer the input signals values into each node are multiplied by each other and a rule firing strength is calculated.

Layer 3: These layer nodes calculate rules relative weight.

Layer 4: This layer is named rules layer which is obtained from multiplication of normalized firing strength (has been resulted in the previous layer) by first order of Sugeno fuzzy rule.

Layer 5: This layer is the last layer of the network and is composed of one node and adds up all inputs of the node.

According to figure 2 the first layer in ANFIS structure will performs fuzzy formation and second layer will be performs fuzzy and fuzzy rules. The third layer will be performs the normalization of the membership functions and the fourth layer will be the conclusive part of fuzzy rules and finally, the last layer will calculates the network output. According to these, it is obvious that the first and fourth layers in ANFIS structure are adaptive layers in which C in layer 1 are known as premise parameters that are related to membership function of fuzzy input. We will instructed ANFIS network by 23 percent of empirical data. 23 percent of primary data which had been considered for testing the appropriate of the modeling were entered into ANFIS model.

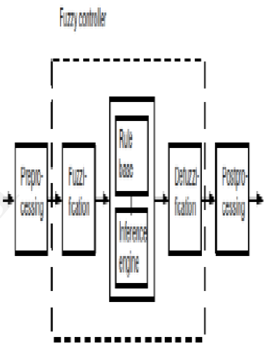

Figure 2

2Results obtained of self-defined method were compared with Anfis. Considering the results, it is obvious that proposed modeling by ANFIS with few numbers of rules and self-defined fuzzy modeling are efficient and valid and it can also be promoted to more general states. In a closed loop current compression cycle, a small portion of the current of bipolar transistor circulates through the cycle components while most of the current stays inside the loop. The worst scenario of current circulation is when large amounts of current become logged in the system. In this paper, an Adaptive Neuro Fuzzy Inference System (ANFIS) and a simple self-defined fuzzy model will be used for modeling the character of important parameters of bipolar transistor. In this way, we may considered the model with two inputs and one output. The input parameters are voltage of collector emitter and current of collector. The output parameter is current of base of transistor. For training Anfis, we prepared data according the transistor characteristics. Then, we will randomly divided empirical data into train and test sections in order to accomplish modeling.

Conclusion

In a closed loop current compression cycle, a small portion of the current of bipolar transistor circulates through the cycle components while most of the current stays inside the loop. The worst scenario of current circulation is when large amounts of current become logged in the system. In this paper, an Adaptive Neuro Fuzzy Inference System (ANFIS) and a simple self-defined fuzzy model are used for modeling the character of important parameters of bipolar transistor. In this way, we considered the model with two inputs and one output. The input parameters are voltage of collector emitter and current of collector. The output parameter is current of base of transistor. For training ANFIS, we prepared data according the transistor characteristics. Then, we randomly divided empirical data into train and test sections in order to accomplish modeling. We instructed ANFIS network by 23 percent of empirical data. 23 percent of primary data which had been considered for testing the appropriate of the modeling were entered into ANFIS model. Results obtained of self-defined method were compared with ANFIS. Considering the results, it is obvious that proposed modeling by ANFIS with few numbers of rules and self-defined fuzzy modeling are efficient and valid and it can also be promoted to more general states.

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