Model of Neuron with Three Dendrites and its Application in Chaos Theory

Kaouther SELMI[1*], Mohamed BOUALLEGUE[2], Kais BOUALLEGUE[2]

[1]FSM, Electronics and Microelectronics laboratory Faculty of Science -University of Monastir, Tunisia
[2]ISSATs, Higher Institute of Applied Sciences and Technologies University of Sousse Tunisia
*Corresponding author's e-mail: Kaouther.selmi@gmail.com

ABSTRACT

The impact of dendrites position on heavies' information remains unknown. We discover that neuron with three dendrites have different behaviors with and without the same activation function. Many methods have been used to construct a hyper chaotic system and several hyper chaotic attractors have been discovered in high dimensional dynamics such as the hyper-chaotic generated by combining fractals processes and chaotic attractors. Our contribution, in this paper, we give new results of chaotic attractors generated by neuron with three dendrites. And we show the impact of degraded neuron with one dendrite on those new chaotic attractors.

Keywords: Neural network, Dendrite, Chaotic

1 Introduction

Neurons are the fundamental units of the brain and nervous system. No prior work has discovered the impact of dendrites position on harvested information to propagate [1], [2]. Within this context, a mathematical model of neurons with variable structure (VSMN) was introduced by Mr. BOUALLEGUE [3]. Its efficiency in creating promising neural networks lead to research into more application.

2 Model of neuron with three dendrites

The following equation system describes the dynamics of the neuron with three dendrites [3,4]:

$$\begin{cases} \dot{u} = -\dfrac{(u + p_1)(u + p_2)(u + p_3)}{\tau} + (u + p_1)(u + p_2)(u + p_3)\, f(\beta v)\, f(\lambda (u + p_1)(u + p_2)(u + p_3)) \\ \dot{v} = -\alpha v + \chi (u + q_1)^{n_1} (u + q_2)^{n_2} (u + q_3)^{n_3} \alpha f^2(\lambda (u + p_1)(u + p_2)(u + p_3)) \end{cases} \quad (2)$$

The value of n_i proper the behavior of neuron.

3 Generation harmonic behavior by neuron with three dendrites

3.1 Harmonic behavior by neuron with two dendrites

Figure 1 shows the harmonic behavior of neuron with two dendrites contains one degraded lob of activation function.

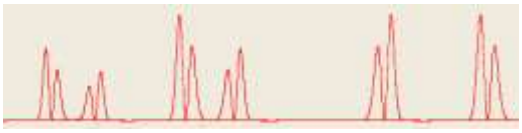

Figure 1: *Harmonic behavior with two dendrites*

3.2 Harmonic behavior by neuron with three dendrites

Figure 2 shows the harmonic behavior of the neuron contains three dendrites without degraded behavior.

DOI: 10.21467/abstracts.163 ISBN: 978-81-965621-5-1 (eBook)

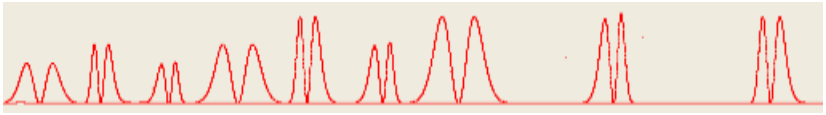

Figure 2: *Harmonic behavior with three dendrites*

4 Results and Discussion

Chaotic attractors by neuron with three dendrites: Figure 3 shows result of chaotic attractors without degraded behavior by neuron with three dendrites.

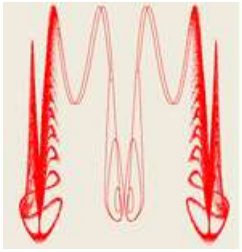

Figure 3: *Chaotic attractor without degraded behavior*

Figure 4 shows result of chaotic attractors with degraded behavior by neuron with three dendrites (left and right degraded behavior).

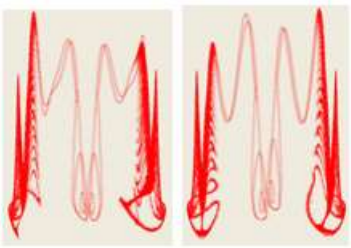

Figure 4: *Chaotic attractor with degraded behavior (left and right degraded behavior)*

We give other examples of chaotic attractors by neuron with three dendrites; this example can used for many applications of security (Figure 5 and Figure 6).

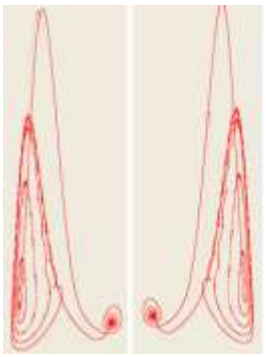

Figure 5: *Symmetry of behavior of chaotic attractor*

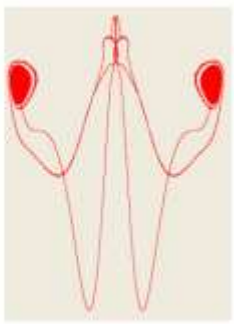

Figure 6: *Another example of behavior of chaotic attractor*

5 Conclusion

There are some potential research directions that could be considered for the future work for many domains such as medicine, signal processing, etc. Moreover, can give some very useful insights to biologists.

6 Acknowledgments

Financial support from University of Monastir (Faculty of Science), Tunisia

ISBN: 978-81-965621-5-1

Series: AIJR Abstracts

DOI: 10.21467/abstracts.163

How to Cite

K. SELMI, M. BOUALLEGUE, K. BOUALLEGUE, “Model of Neuron with Three Dendrites and its Application in Chaos Theory”, *AIJR Abstracts*, pp. 85–87, Feb. 2024.

References

[1] G. Lee and N.H. Farhat (2001) GLE01G. Lee and N.H. Farhat” The Bifurcating Neuron Network,” Neural Networks 14, pp.115-131.

[2] Ghaith. Bouallegue. Lotfi. Hamrouni and kais. Bouallegue(2020)Signal Devices (SSD), IEEE ”Neuron Model With Two Dendrites and its Behaviors” (2020) pp.597-603.

[3] Kais Bouallegue (2017) “A new class of neural networks and its applications”. In: Neurocomputing 249, 2017, pp. 28–47

[4] Kais. Bouallegue(2015)”Gallery of Chaotic Attractors Generated by Fractal Network,” Int. J. Bifurcation and Chaos 25,1, pp. 1530002-18.

ISBN: 978-81-965621-5-1

Series: AIJR Abstracts

DOI: 10.21467/abstracts.163