EE 550
Artificial Neural Networks
Homework 6 (Bonus)

Due: 13/06/2020

Continuous Type Hopfield Model This project requires the simulation of a continuous type Hopfield model we have discussed in class. You can use graphical tools for the required that you are familiar with.

A two-neuron continuous type Hopfield model is given with the following parameters. The interconnection matrix is given as

$$T = \begin{bmatrix} 0 & 1 \\ 1 & 0 \end{bmatrix}$$

And the nonlinear activation function for each neuron is given as

$$g(u) = (2/\pi)\arctan((\lambda\pi u)/2)$$

Resistors and capacitances are set to 1. Initially λ is set to 1.4 as in Ref. [1].

1) First find the equilibrium points for the above system. Then plot the energy contour maps with 6 different energy levels as we have discussed in the class. Choose energy contours at $0.449, 0.156, 0.017, -0.003, -0.023$ and -0.041 as in the Ref. [2].

2) Simulate this dynamic system with an initial state close to one of the stable equilibrium points. Plot the convergence of state trajectory to that equilibrium point on the same energy plot (i.e., plot the outputs of the two neurons on the same graph showing convergence to the stable eq. point).

3) Then start increasing λ continuously with a step size of 0.1 and plot the movement of the two stable equilibrium points towards the corners of the hypercube.

References

[1] M.K. Ciliz and A. Harova, "Stability Regions of Recurrent Type Neural Networks", Electronics Letters, Vol. 28, No 11, pp.1022- 1024, May 1992.

[2] J. J. Hopfield, "Neurons with graded response have collective computational properties like those of two state neurons" Porc. Nat. Acd. Sci., Vol. 81,pp.3088-3092, May 1984.

NOTES:

1) Please upload all your files (codes and report) to Moodle with the file convention `Lastname_Firstname_project6_bonus.rar`.

2) Plagiarism will not be tolerated.

3) Late submission will not be accepted.