

Two corrections 05/10/07; in #2 $N=7$ should be $N=6$, one $Z(0)$ should be $Z(t)$

EE 434 Final Exam Spring 2007

Take home – due end of final exam period (3:30pm) W 05/16/07 to Ms. Yu Jiang, Room AV Williams 1353.

Open book, open notes, computer can be used. Your submitted results should be organized so they can be easily understood for grading purposes. Signed submission declares that all of the work is your own and no consultation on the questions has occurred. Good LUCK.

#1. (50 points)[stability with momentum]

- Problem E12.3, p. 12-50, of the text.
- For that problem find γ as a (possibly set valued) function of α for which the algorithm is stable.

2. (50 points)[evolution of polygons]

Here a given N -gon (a polygon with N joints [=vertices]) has its joint x - y coordinates given by (x_i, y_i) for $i=1, \dots, N$. A straight line connects consecutive joints and the N th one connects to the first (for $N=3$, with 3 generic joints this is a triangle).

For this problem all weight matrices are to be of the form of the following $N \times N$ matrix (illustrated for $N=6$, each row is a cyclic shift to the right of the one above it with the first and last rows wrapped around as illustrated)

$$W := \begin{bmatrix} -2 & 1 & 0 & 0 & 0 & 1 \\ 1 & -2 & 1 & 0 & 0 & 0 \\ 0 & 1 & -2 & 1 & 0 & 0 \\ 0 & 0 & 1 & -2 & 1 & 0 \\ 0 & 0 & 0 & 1 & -2 & 1 \\ 1 & 0 & 0 & 0 & 1 & -2 \end{bmatrix}$$

Form a neural network for which the N -vector input $Z(t) = X(t) + Y(t)*j$, $j = \sqrt{-1}$, yields an output N -vector, $z(t)$, by adding Z to the delayed output, $z(t-1)$, and then is multiplied by W , followed by a $\text{purelin}(\cdot)$ activation function to give the output z .

- Give the difference equations describing the neural network in t for integer $t \geq 0$, assuming the output, at $t=-1$, is the zero N -vector..
- For $i=1, \dots, N$ form $X_i(0) = x_i(0) = \cos(2\pi*i/N)$ and $Y_i(0) = y_i(0) = \sin(2\pi*i/N)$ for the initial input $Z(0) = X(0) + Y(0)*j$ and for $t > 0$ $Z(t) = 0$, the zero N -vector. For $t \geq 0$ the joints are at the output (x_i, y_i) coordinates as the real and imaginary parts of $z(t)$.
- Write an m -file, `ANNgon.m` which takes as input N , $Z(t)$, the final time T , runs your neural network, and plots the N -gon of joints $z(t)$.
- Give your plots for pentagons, $N=5$, and various T ($T=1$, $T=5$, $T=20$).
- Repeat part c) when the 3rd and 4th joints are interchanged.
- Investigate larger N and discuss your result.

Hint: Matlab will plot your N -gon with complex z by `plot(z)`; you will need to append the first point to close the N -gon.