BT6270: Computational Neuroscience

The details of Assignment-3 are given below

Assignment description:

For this assignment, consider two Hopf oscillators (equation given below) coupled together. Calculate the coupling coefficients (w_{12} and w_{21}) required to achieve a given phase difference in the between the oscillators. Two types of coupling are to be considered

- Complex coupling

    ○ phase difference $= -47^0$, $\omega_1 = \omega_2 = 5$

    ○ phase difference $= 98^0$, $\omega_1 = \omega_2 = 5$

- Power coupling.

    ○ Normalized phase difference $= -47^0$, $\omega_1 = 5$, $\omega_2 = 15$

    ○ Normalized phase difference $= 98^0$, $\omega_1 = 5$, $\omega_2 = 15$

Hopf oscillator equations are given as follows,

$$\dot{x} = -y + \mu x(1 - x^2 - y^2)$$

$$\dot{y} = -x + \mu y(1 - x^2 - y^2)$$

In polar coordinates, the equations become,

$$x = r \cos \cos \theta, \ y = r \sin \sin \theta$$

$$\dot{r} = \mu r(1 - r^2)$$

$$\dot{\theta} = 1$$

The report should consist of the following things for each case of power coupling and complex coupling:

1. The parameters used to achieve the phase difference.
2. Response of oscillators over time.
3. Phase difference between the oscillators (for complex coupling) and normalized phase difference between the oscillators (for power coupling) over time.
4. Observations and conclusions made for each case.

Submission link:

General Instructions:

- Submit a pdf file containing a detailed report showing all the plots mentioned above. Label the figures clearly and label the axis of the plots properly with required units. Write brief comments regarding the observations made for each case. Please be very crisp and clear in the comments.

  Kindly name your report as follows: ROLLNO_A3.zip, **Eg:** BT22D109_A3.pdf

- A code file containing the code to simulate above graphs (either matlab or python). Note that the code file should be clearly annotated and you would also be graded accordingly.

  Kindly name your code as follows: ROLLNO_A3.ipynb or ROLLNO_A3.m Eg: BT22D109_A3.ipynb, BT22D109_A3.m

  Mention any reference codes you have used to simulate the assignment.

- Please email the TAs for any clarifications

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Please note this is an individual assignment. Please do not share your assignment with other students. Any form of plagiarism found, the assignment will be considered null and the assignment score will be set to zero.

The deadline for Assignment-2 is 10/11/2025, 23:59. The form link gets disabled beyond the deadline.

Delay in submitting the assignment will only be accepted if found valid reason, and should be informed to both the TAs at least 3 days before the due date via email.