

EE 580 Network Systems: Modelling & Analysis

Lab Assignment 1

Assigned: August 31, 2022

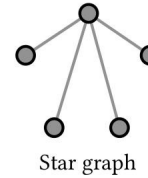
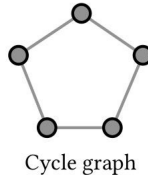
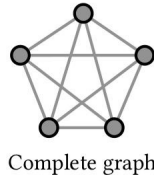
Due: September 7, 2022

Use MATLAB, C or any other language of your choice to perform the following computations/simulations. The plots must be legible with appropriately chosen axes labels, ticks and legends. Typeset your answers, plots and explanation in a LibreOffice or L^AT_EX document, save as .pdf. Upload the pdf document and your code in Moodle.

1. Simulate the linear averaging algorithm

$$x_i^+ := \text{average}(x_i, \{x_j, \text{for all neighbor nodes } j\}). \quad (1)$$

Imagine a network with 5 nodes, set the initial state as $(1, -1, 1, -1, 1)$, and use the graphs shown below. Which value do the nodes converge to? Is it equal to the average of the initial values? Comment on the relationship between the connectivity of the network and the number of iterations required to reach consensus?



2. Imagine that the x_i in the above network is the position of the node. In which case, achieving consensus would mean that all the nodes move towards a common position. Each node can communicate with nodes within a particular distance from itself, *i.e.* neighbors of node i denoted as \mathcal{N}_i can be expressed as

$$\mathcal{N}_i = \{x_j : \|x_i - x_j\| \leq r, \forall j \neq i \text{ and } r > 0\}.$$

In every iteration, each node updates its position using equation (1).

Simulate the movement of 5 nodes that are uniformly distributed in a 1 unit x 1 unit square in \mathbb{R}^2 adhering to the conditions described above. Choose an appropriate value for the communication range r . Plot the position of each node (within the square) in every iteration. You may choose the most significant of these plots to put in your report.

3. Repeat the simulation in (2) to compare the time taken for the nodes to converge to the common point for different values of the communication range r . Choose atleast 5 values for r , and represent the comparison of convergence time graphically. Comment on the comparison and make inferences.