SC627 Assignment3

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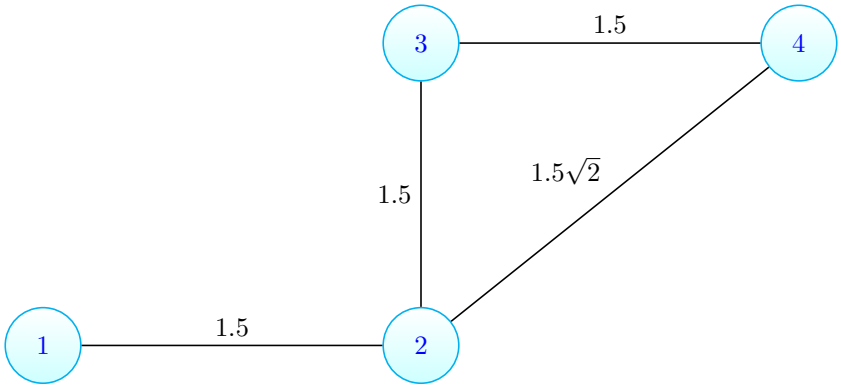
1 Introduction

In this assignment, heading consensus and frequency synchronization were performed using 4 turtlebots. An underlying weighted undirected graph was used and a distributed control law was implemented according to neighbors of each turtlebot.

2 Underlying Graph and Control Law

The underlying communication graph used is shown below:



The control law used were:

1. **Consensus**

   $\dot{\theta} = -L\theta$

   where, θ is the state vector consisting of headings of 4 turtlebots and L is the laplacian of graph described above

2. **Frequency Synchronization**

   $\dot{\theta}_i = w_i - \sum_{j \in N_i} a_{ij} sin(\theta_i - \theta_j)$

   where $w_1 = 0.8$, $w_2 = 0.9$, $w_3 = 1.2$, $w_4 = 1.1$

here, $L = \begin{bmatrix} 1.5 & -1.5 & 0 & 0 \\ -1.5 & 3 + 1.5\sqrt{2} & -1.5 & -1.5\sqrt{2} \\ 0 & -1.5 & 3 & -1.5 \\ 0 & -1.5\sqrt{2} & -1.5 & 1.5 + \sqrt{2} \end{bmatrix}$

3 Simulation Results

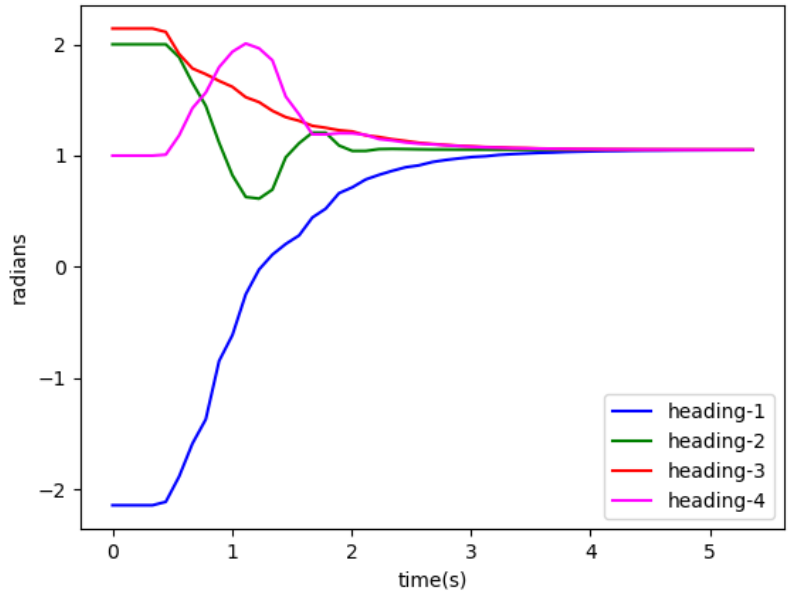


Figure 1: Heading consensus

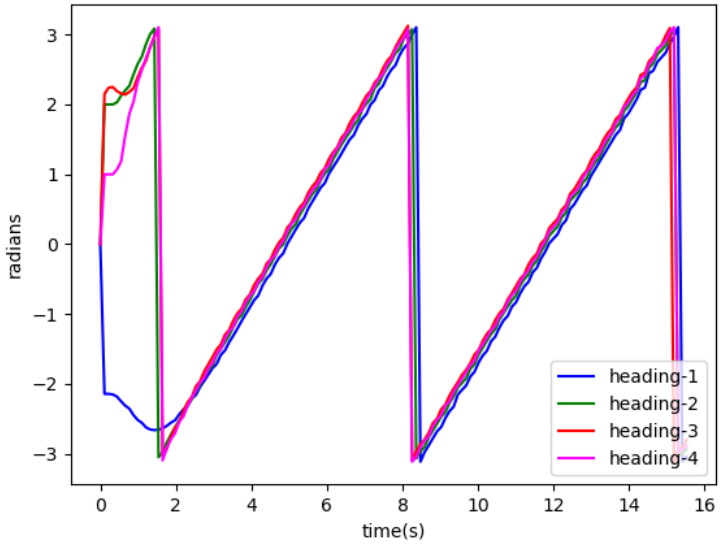


Figure 2: frequency sync: shows variation of headings

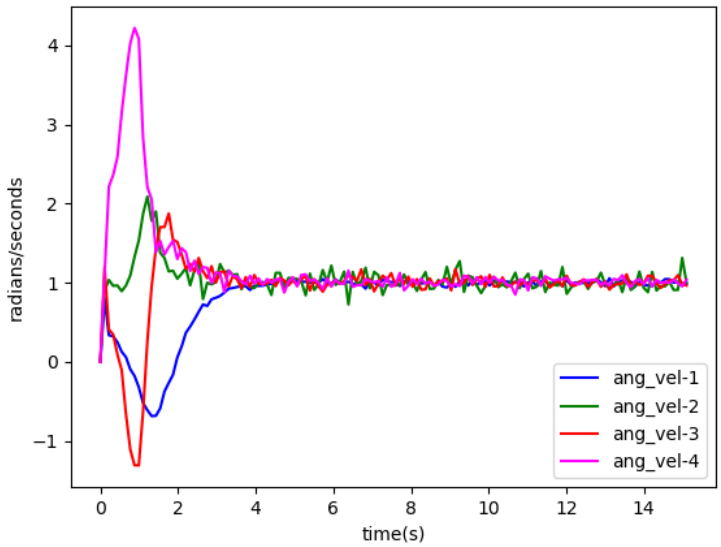


Figure 3: frequency sync: shows convergence of angular velocity

Figure 2 shows frequency synchronization where all bots rotate with same angular velocity. As can be seen in figure that after '2-seconds' the rate at which headings vary are same for all 4 implying the convergence of angular velocity

4 References

1. Mesbahi, Mehran, and Magnus Egerstedt. "Graph theoretic methods in multiagent networks." In Graph Theoretic Methods in Multiagent Networks. Princeton University Press, 2010.