ECE 675 Spring 2022

FunWork #1

Due on February 03

- You may work on this FunWork by yourself or with classmates. No more than three persons per group.
- One write-up per group; it must be typed.
- In this FunWork, synchronous and asynchronous neural models of different types of networks will be studied, for example, social networks or economic networks. We will study models' stability properties using LaSalle's Invariance Principle.
- Social network analysis is devoted to the study of groups of social agents such as individuals or organizations that interact according to social relationships. Individuals in a social network interact and exchange their opinions on different issues. A challenge is to construct models that capture observed social interactions. Attempts have been undertaken to quantify the concepts of social power and social influence of an individual agent in a social network, see, for example [1, 2, 3, 4, 5]. Individual social power is the amount of influence an individual has on overall opinion in the individual's social network. The social power of an individual in a group can vary in time as the network members interact and are influenced by each other.

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1. Use one of the papers from the References, for example, the paper by Chan et al. [6], to decide about your type of network. A possible way to begin is to consider a network, denoted $\mathcal{N}$ that consists of N agents, $x_1, x_2, \ldots, x_N$. At the beginning of our modeling process of a given network, we ask the members of the network to fill out a survey to express their opinions on a given set of issues, $\boldsymbol{a}_j$, $j = 1, 2, \ldots, r$. We can use, for example, a three-, or five-, or seven-point Likert scale with a neutral midpoint. Thus we have a pair $(\mathcal{N}, \mathcal{A})$ that characterizes the social network at hand, where $\mathcal{N} = \{x_1, x_2, \ldots, x_N\}$ and $\mathcal{A} = \{\boldsymbol{a}_1, \boldsymbol{a}_2, \ldots, \boldsymbol{a}_r\}$.

   The results of the survey can be represented in a tabular format. We illustrate the above concepts with the following simple example.

Table 1: Beliefs of users, where $\{\boldsymbol{a}_1, \boldsymbol{a}_2, \boldsymbol{a}_3\}$ are propositions (facts or positions), $\{x_1, \ldots, x_5\}$ are users. Values are on a 5-point scale, with 5 indicating full agreement.

	$\boldsymbol{a}_1$	$\boldsymbol{a}_2$	$\boldsymbol{a}_3$
x_1	5	4	5
x_2	2	3	2
x_3	1	1	1
x_4	3	3	3
x_5	5	4	5

Example 1 Let $\mathcal{N} = \{x_1, x_2, x_3, x_4, x_5\}$ and $\mathcal{A} = \{\boldsymbol{a}_1, \boldsymbol{a}_2, \boldsymbol{a}_3\}$. Then the results of a survey using a five-point scale with a neutral midpoint are shown in Table 1.

2. Use the paper by Chan et al. [6] to construct a synchronous neural network modeling your network.

3. Perform preliminary simulations of your network.

4. Submit only html or pdf file of your MATLAB m-file prepared using the cell mode. Use the publish button in the tool-bar to obtain an html file, or go to the workspace and type

   ```
   publish('your m-file name without extension','pdf')
   ```

   to obtain a pdf file. Submit either html or pdf file.

References

[1] P. Jia, A. MirTabatabaei, N. E. Friedkin, and F. Bullo, "Opinion dynamics and the evolution of social power in influence networks," *SIAM Review*, vol. 57, no. 3, pp. 367–397, 2015.

[2] A. V. Proskurnikov and R. Tempo, "A tutorial on modeling and analysis of dynamic social networks. Part I," *Annual Reviews in Control*, vol. 43, pp. 65–79, 2017.

[3] A. V. Proskurnikov and R. Tempo, "A tutorial on modeling and analysis of dynamic social networks. Part II," *Annual Reviews in Control*, vol. 45, pp. 166–190, 2018.

[4] A. V. Proskurnikov, C. Ravazzi, and F. Dabbene, "Dynamics and structure of social networks from a systems and control viewpoint: A survey of Roberto Tempo's contributions," *Online Social Networks and Media*, vol. 7, pp. 45–59, 2018.

[5] M. Ye, J. Liu, B. D. O. Anderson, C. Yu, and T. Başar, "Evolution of social power in social networks with dynamic topology," *IEEE Transactions on Automatic Control*, vol. 63, pp. 3793–3808, November 2018.

[6] H. Y. Chan, S. Hui, and S. H. Żak, "Synchronous and asynchronous Brain-State-in-a-Box information system neural models," *Int. J. Neural Systems*, vol. 9, pp. 61–74, February 1999.