Exercise set # 3 for the course
"Networked Dynamical Systems"

Claudio Altafini
Linköping University

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1. **Bounded Confidence**

   Consider the following consensus-like algorithm in $\mathbb{R}^n$

   $$\dot{x}(t) = \sum_{j \text{ s.t. } |x_j(t)-x_i(t)|<1} (x_j(t) - x_i(t)) \tag{1}$$

   The interpretation of (1) is that only nodes that are closed enough to node i contribute to the summation at each t. By theoretical analysis and/or by numerical simulation you should understand the behavior of this scheme.

2. **Signed consensus**

   If instead of (1) one uses the following algorithm

   $$\dot{x}(t) = \sum_{j \neq i} \big(\text{sign}\big(x_j(0)x_i(0)\big)x_j(t) - x_i(t)\big) \tag{2}$$

   where $\text{sign}(\cdot)$ is the sign function and $x(0) \in \mathbb{R}^n$ is the initial condition of the system (2). What is the behavior of the system?

3. What changes if instead of (2) one uses

   $$\dot{x}(t) = \sum_{j \neq i} \big(\text{sign}\big(x_j(t)x_i(t)\big)x_j(t) - x_i(t)\big) \tag{3}$$

   Do you have an interpretation/conjecture?

4. Is it possible to combine the two models (1) and (2) (or perhaps (1) and (3)) into a signed bounded confidence model?