Contributions
Distributed Observer Design is used for:
• Fault Detection
• Leader Selection

In this work we use:
• Nonlinear observers to estimate the states of the agents in a robotic network.
• Linear Matrix Inequalities to prove the stability of the observers.
• Markov chains to prove the stability of leader selection algorithm.

Idea: Leader Activity as Disturbance
Agents assume no leader is present, so the network is "settled".
• Introduction of the leader is similar to an external fault in the system, i.e. "unsettles" it.
• The idea is to detect the existence of fault distributedly at each agent.
• This is done through designing observers at each agent for estimating the states of the "nominal" system (General Observer Scheme).

Leader Selection Algorithm
• Leadership and selection of a leader can be observed among social animals, e.g. human, and canis lupus.
• The presence of a leader is necessary to accomplish some of the tasks in robotic networks as well.

A Robotic Network
Without a Leader
With a Leader

Example: The average number of steps for the leader selection algorithm to terminate for a formation of n=10 agents and N=10 is 25.

Comparison with ALOHA
Simulation Results

Conclusions
• Only local measurements and a knowledge of the structure of the underlying graph of the formation at each agent.
• The algorithm relies on existence of state observers at each agent.

Future Work
• Considering time varying inter-connection graphs.
• Emulating other social behaviours observed in social animals.