MAE 598 Project Proposal Guidelines

You will choose a particular type of collective behavior to study for your project. Your project must include the following:

(1) A literature review of related research on multi-robot systems and, if relevant, studies of related collective behaviors in nature.

(2) A mathematical model of the collective behavior. At minimum, you can use an existing model. For more points, expand upon an existing model or develop your own model using the techniques covered in class.

(3) A theoretical analysis of at minimum 2 properties of the model; for example, the model's equilibrium state, largest invariance set, stability characteristics (ex. asymptotically stable/marginally stable), or convergence rate to equilibrium. For more points, design a controller for the model to achieve a desired collective behavior.

(4) A validation of your theoretical analysis through either simulations or experiments of the collective behavior. You must present (a) plots of your results, and (b) simulation movies or experimental video recordings of the collective performing the behavior of interest. At minimum, develop simulations in MATLAB. For more points, develop simulations in a multi-robot simulator such as the Robotarium simulator, available in both MATLAB and Python (https://www.robotarium.gatech.edu/); V-REP (http://www.coppeliarobotics.com/); or Webots (https://www.cyberbotics.com/overview); or run experiments with actual robotic hardware.

You will write a final report on your project that will be due on **Dec. 6 at 11:59pm** (submit through Blackboard).

Template for Project Proposal

Due date: Nov. 5 at 11:59pm (submit through Blackboard)
Length: 1.5 – 2 pages

Project title: Give a tentative title

Team members: List the names of the students collaborating on the project. One to four students may work on the same project. Note that the scope of the project must be scaled appropriately for team projects, and you will be required to state the contribution of each team member in your final report.

Project objective: Discuss the type of collective behavior that you will study and the particular properties of the behavior that you will investigate in your project. Discuss potential applications of this behavior for multi-robot systems in practice.

Methodology: Describe the modeling approach that you will use to describe the collective behavior, the techniques that you will use to analyze (and control, if you choose) properties of the model, and the simulation software or experimental hardware that you will use to validate your analysis. Discuss the particular set of computational or hardware experiments that you will run and state the number(s) of robots that you will test, the environment parameters, the model parameters that you will vary, the results that you will plot, the videos that you will generate, and any other relevant details.

Division of labor: If more than one student will be working on the project, describe what each team member will contribute.

References: Cite at least 5 publications that will be referenced in the literature review of your final report. They may be papers that we discussed in class or other references.