Distributed Formation Control

**Goal**
Using only local information, develop an algorithm for moving nodes into predetermined formations

**Applications**
- UAV control, robotics
- Distributed network coordination
- Industrial production, aerospace, and military affairs

**Algorithm**
1. Calculate summation of \( f \) (Equation I)
2. If sum is less than or equal to appropriate error, formation complete and exit
3. Else, loop through each node
   a. Loop through each neighbor node
      i. Calculate derivative of \( f \) (equation III)
      ii. Save derivative to temporary sum
   b. Update position using sum of \( P \) and a descent factor (alpha, equation IV)
4. Loop to step 1

**Methods**
- Solving the system as a convex optimization problem
- Using \( f \) as the error function, gradient descent is implemented on each node in relation to their neighbors to search for the formation
- MATLAB used to simulate formation and demonstrate working algorithm

**Gradient Decent**
- Technique used for computationally and discretely determining the local minimum of a function
- Cannot find global minimums, however. Minimum found is based on topology of function

**Future Expansions**
- Real-world implementation in small UAVs
- Additional of random “noise” to each descent descent step to help alleviate fixations on “shallow” minimums
- Add code for collision detection and avoidance

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