Simulation and Improvement of Non-Obstacle Flocking for Multi-agents System with a Virtual Leader

Wang, Dongqing (School: Lyceum "Holosiyivky" No. 241)

To simulate nearly natural behavior of animal flocks, scientists standardized such habits of animals with rules to create mathematical algorithms. These algorithms adapt advantages of natural habits to solve flocking control problems. If the state of leader is unstable relative to time flow, how should flock mates track down their own leader for convenience of lowest possible range of information emitted? I studied the work of Olfati-Saber, a robust simulation of flocking in alpha-lattice structure. He modeled individual movement within a flock under ordinary differential equations. Under his theory, each agent possesses feedback-tracking information from leader. But it overestimates the range of information emitted by leader for agents to follow. In my modifying theory, emitted range can be minimized if movements of agents are predictable. I defined Leader Scope as range leader emitted to lead its agents, and Attraction Radius as the range for agents to be controlled by leader. I proposed that to maintain successful flocking control, the range of attraction radius must be no less than leader scope, and the equation for the lower limit of attraction radius stands when agents move toward their leader in straight lines, prescriptively. Also, upper limit of attraction radius is reached when agents move in hyperbolic trajectory, which is the proposed situation in Saber’s theory. With that said, the circumstance in Saber’s algorithm is a special case in my theory. By controlling the track of agents to lower the range of information emitted by the leader according to my theory, resources can be applied elsewhere.