

Chases and Escapes with Groups

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"Chases and Escapes" is a traditional mathematical problem. Typically, the problem is to find a path of the chaser given a path of escapees. Even with simple set ups, such as the escapee moves in a circle with a constant speed, the path of the chaser can be rather complex. Mostly the cases of one chaser and one escapee have been considered.

Recently, we have proposed a simple extended model where one group chasing another group, called a "Group Chase and Escape". This extension connects the traditional problem with current interests on collective motions of animals, insects, cars, etc. I will present our basic model and its rather complex and rich behaviors. Each chaser approaches its nearest escapee while each escapee steps away from its nearest chaser. Although there are no communications within each group, aggregate formations are observed. How these behaviors appear as a function of parameters, such as densities will be discussed.

Also, we consider different expansion of this basic model. First, we introduced a fluctuation. Players now make errors in taking their step directions with some probability. It turns out that some level of fluctuations works better for more effective catching. Secondly, we introduce delay in the reaction of chasers in catching a target. Distance dependent reaction delay can cause quite complex behaviors. We also discuss the direction of applications of chases and escapes to the constrained optimization problem.

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