Modeling of Adaptive Behaviors in Crickets

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Insects provide good model systems to investigate neuronal mechanism underlying adaptive behavior (Fig. 1). Aggressive behavior of male cricket is released by cuticular substances on the body surface of male cricket and the aggression levels escalate until one of male crickets evacuate from the fighting. This agonistic behavior establishes social status between two male crickets (Fig. 2). We have been investigating how animals behave in the social population. Cricket agonistic behavior must be a good model system to understand the mechanism of social status formation. Here, we perform mathematical modeling of the male-male interaction among cricket population to investigate how animals organize sociality (Fig. 3). Individual interaction among crickets was simulated by constructing artificial cricket model (Fig. 4). This model was constructed by observation of cricket behaviors in a population and probability P of a behavior pattern was given where P is dependent on a component of time decay and memory which we determine as α. Using this simulator, we examine the effect of social population on the crickets behaviors. When the population of cricket has low density, fighting behavior showed rather random pattern. When the population has middle density, only one of crickets did beat other crickets to keep dominant status. When the population has high density, almost all crickets always moved to avoid interaction among other crickets. This modeling could simulate mechanisms underlying social behavior in insects and that, in turn, must help us to understand neuronal mechanisms underlying adaptive behaviors.

Keywords: artificial cricket, sociality, social behavior

References

1) J. Nagamoto, H. Aonuma and M.Hisada: “Discrimination of conspecific individual via cuticular pheromones by males of the cricket Gryllus bimaculatus,” Zool. Sci., Vol. 22, pp. 1079~1088, 2005.

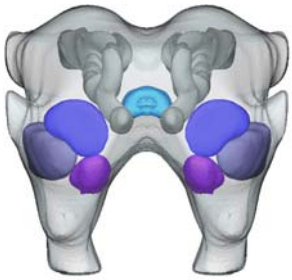

Fig. 1 Brain of cricket

Fig. 2 Fighting behavior of male crickets

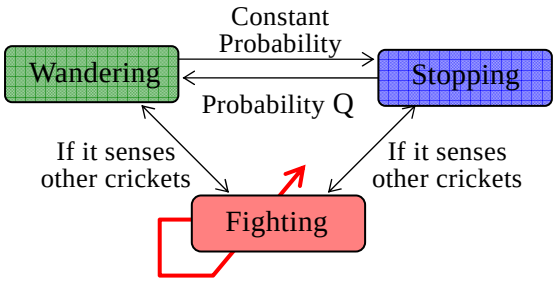

Fig. 3 Finite automaton model of cricket’s behavior

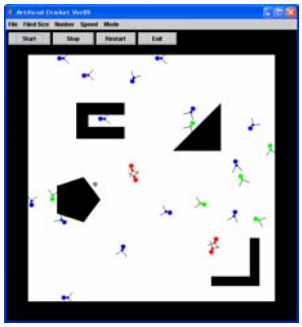

Fig. 4 Simulation of artificial crickets