

# An Adaptive Gravity Model for Interactions in Insect Swarms

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**Abstract.** The collective motion of groups of animals emerges from the net effect of the interactions between individual members of the group. In many cases, such as birds, fish, or ungulates, these interactions are mediated by sensory stimuli that predominantly arise from nearby neighbors. But not all stimuli in animal groups are short range. Here, we consider mating swarms of midges, which interact primarily via long-range acoustic stimuli. We exploit the similarity in form between the decay of acoustic and gravitational sources to build a model for swarm behavior. By appropriately accounting for the adaptive nature of the midges' acoustic sensing, we show that our "adaptive gravity" model makes mean-field predictions that agree well with experimental observations of laboratory swarms. This is a novel model, where long-range interactions are responsible for collective animal behavior.