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Collective fluid mechanics of honeybee nest ventilation NICK GRAVISH, SEAS & OEB, Harvard University, STACEY COMBES, OEB, Harvard University, ROBERT J. WOOD, SEAS, Harvard University, JACOB PETERS, OEB, Harvard University — Honeybees thermoregulate their brood in the warm summer months by collectively fanning their wings and creating air flow through the nest. During nest ventilation workers flap their wings in close proximity in which wings continuously operate in unsteady oncoming flows (i.e. the wake of neighboring worker bees) and near the ground. The fluid mechanics of this collective aerodynamic phenomena are unstudied and may play an important role in the physiology of colony life. We have performed field and laboratory observations of the nest ventilation wing kinematics and air flow generated by individuals and groups of honeybee workers. Inspired from these field observations we describe here a robotic model system to study collective flapping wing aerodynamics. We microfabricate arrays of 1.4 cm long flapping wings and observe the air flow generated by arrays of two or more fanning robotic wings. We vary phase, frequency, and separation distance among wings and find that net output flow is enhanced when wings operate at the appropriate phase-distance relationship to catch shed vortices from neighboring wings. These results suggest that by varying position within the fanning array honeybee workers may benefit from collective aerodynamic interactions during nest ventilation.

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