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Inverse modelling of honeybee hives weight dynamics

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A detailed quantitative analysis of bee colony dynamics is essential for supporting global initiatives aimed at enhancing bee health and bolstering pollination activities. Critical metrics, such as foraging efficiency and the number of actively foraging bees, play a vital role in developing predictive early-warning systems for identifying potential colony collapse or decline.

Mathematical and informational modeling emerges as an indispensable tool in this context, providing structured insights into complex colony behaviors and interactions. Particularly, precise calibration of these mathematical models is of paramount importance. In this paper, we solve ODE inverse problem to fit the complex dynamics of the bees within a hive, and to study their complicated behaviour during the day, which includes foraging and producing honey [1]. By accurately calibrating models to collected data, one can refine predictions, better understand underlying mechanisms of colony dynamics, and formulate effective interventions to safeguard bee populations and their critical ecosystem services. Computational results with synthetic and realistic data are discussed.

Keywords: honeybee population dynamics, daily weight variation, least-squares fitting

MSC2020: 34A55, 65L09, 92D25

References

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