Sight-reading the flight(s) of the bumblebee

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Bees face the complex challenge of exploiting patchily distributed food resources that replenish over time. How do they locate individual resources? How do they choose them? How do they move between them? How do they return to their nest once loaded with food? And how do they cope with competitors? Despite more than a century of research on bee cognition, these questions are only partially resolved, primarily because of the difficulty to monitor and quantify the behaviour of bees in their natural environment, which typically involves tracking individuals over large spatio-temporal scales. Here we will present experimental data of bumblebees foraging in large arrays of artificial flowers equipped with automated tracking systems to record the complete foraging history and competitive interactions of multiple individuals over several consecutive hours. We will show how spatial network analyses (in which flight segments are edges and flowers are vertices) can help characterizing and model space use by individuals and colonies, as bees learn the spatial configuration and reward values of available feeding sites, as well as keep track of previous encounters with other foragers. Our results show that bees dynamically integrate both private and public information to develop efficient route memories. Computational models based on these observations can then be used to predict the complex patterns of bees movements in more complex, naturalistic environments.