Finding home without knowing where you are: Visually guided navigation without mapping or object recognition

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Abstract. The use of visual information for navigation appears to be a universal strategy for sighted animals. One particular group of expert navigators are the ants. The interest in studies of ant navigation is in part due to their small brains; biomimetic engineers take inspiration from simple, elegant control solutions, while biologists seek a description of the minimal cognitive requirements for complex spatial behaviours. In this spirit, I will describe a parsimonious model of visually guided navigation of ants in which we show that navigation can be achieved without complex cognitive components such as a map-like representation. Indeed, the ant navigates without ever knowing where it is, or processing the visual world into discrete objects.

A combination of behavioural experiments, computational analyses and modelling has led us to develop an algorithm which successfully navigates visually complex worlds, with routes that show many characteristics of desert ants. The algorithm is driven by simple behavioural routines which enable navigation using familiarity detection rather than explicit recall; the agent simply moves in directions that appear familiar rather than trying to localise itself. As such, visual input is associated not with particular places but instead with actions, that is: What should I do? not Where am I?. This greatly simplifies the problem of navigation allowing robust performance with simple computation, meaning routes can be learnt by a single layer neural network after one training run without object recognition or specifying when or what to learn.

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