

Immersive Visual Analysis of Insect Flight Behaviour

Huyen Nguyen*

Florence Wang†

Raymond Williams²
Paulo de Souza¹

Ulrich Engelke²

Alex Kruger¹

¹Data61 (Sandy Bay TAS 7005) and Information Management & Technology (Clayton VIC 3168)
Commonwealth Scientific and Industrial Research Organisation (CSIRO), Australia



Figure 1: Immersive visualisation of bee flight behaviour. The bird's-eye view provides a global view of the virtual environment with flight paths in a 3D geo-spatial context. The tracking viewpoint (bottom left) provides a close-up perspective on bee flight movements. A drop down menu allows to change different attributes of the tracking data and related visualisation of the paths.

ABSTRACT

We present *I-Flight*, a virtual reality based visual analysis system for insect movement data. *I-Flight* aids in understanding insect movements and collective flight behaviour in a simulated environment. Towards this end, *I-Flight* visualises insect flight paths in their natural, 3D geo-spatial context. In this paper, we demonstrate the use of *I-Flight* for honey bee flight data and related environmental variables. The system is designed to be extensible to other insect flight data by adopting the data attribute space and the respective mapping onto visual variables, such as colours. The value of the presented *I-Flight* system is not only in complementing existing scientific methods and tools for understanding honey bee behaviour, but also in raising broader awareness for honey bee preservation through an engaging, immersive environment.

Index Terms: H.5.1 [Information Interfaces and Presentation (e.g., HCI)]: Multimedia, Information Systems; H.5.2 [Information Interfaces and Presentation (e.g., HCI)]: User Interfaces (D.2.2, H.1.2, I.5.6)

*e-mail: huyen.nguyen@csiro.au

†e-mail: florence.wang@csiro.au

e-mail: ray.williams@csiro.au

e-mail: ulrich.engelke@csiro.au

e-mail: alex.kruger@csiro.au

e-mail: paulo.de.souza@csiro.au

1 INTRODUCTION

Foraging and collecting food are essential behaviours of insects to secure their own survival and that of the colony. Understanding foraging behaviour is of great interest to the scientific community and to ecologists in particular. For insect species that feed on plants, for instance honey bees, these activities involve a large range of collective behaviours as a swarm, from forming foraging strategies (increased activity that maximises their chances of encountering a plant, completely random activity, or sensory attraction to a plant from a distance) to executing the exploration phase and periodically monitoring food availability [11]. These activities are repeated in flight cycles that are established and partially decided by environmental factors, including air temperature, humidity, precipitation, and time of day. Ecologists have uncovered many peculiar flight movements of insects, such as rapid changes in flight direction, vertical take-off and landing, upside-down flying, and lateral and backward movement [5, 14].

The study of insect flight has been advanced in recent years but most of the visualisation work focused on flow features and wing aerodynamics during flight via conventional desktop displays [4, 10]. With the rise of commercial head mounted displays, such as Oculus Rift¹ and HTC Vive², immersive technology has become more accessible. Previous studies comparing immersive technology with desktop displays demonstrated the benefits of immersion in acquisition of spatial knowledge [1, 9]. In this paper we therefore explore virtual reality for immersive visual analysis of insect flight

¹<https://www.oculus.com/>

²<https://www.vrnet.com/>

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