Centre for Transport & Society

RESEARCH BRIEFING SHEET 044
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INTERDISCIPLINARY STUDY OF CROWD BEHAVIOUR

Background

Prediction and control of crowd flow is particularly urgent at bottlenecks in traffic networks and public spaces such as railway stations, airports or shopping malls. Crowd behaviour is relevant to aspects such as safety and security, natural disasters, emergency evacuations, and terrorist attacks.

Travel behaviour focuses on understanding individual behaviour and behavioural change which informs the planning and design of public spaces. Similarities have been observed between human behaviour in the built environment and collective animal behaviour in the natural environment. The study of social insects is of a particular relevance here since they are seen as model organisms for understanding fundamental principles of spatial cognition, social interactions, and crowd behaviour.

This research aims to optimise individual rules for behaviour in crowded traffic conditions as an advice to humans and also to facilitate design and organisation. To the best of our knowledge, nobody has drawn comparisons to identify similarities and differences or evaluate the potential for a multidisciplinary approach. Here we propose to bridge this gap by concentrating on the role of social interaction. Attempts to address this issue come from hitherto disparate fields such as travel behaviour, collective animal behaviour and complex systems theory.

Crowds in Kyoto Station, Japan quickly disperse out of ticket gates.

Project Overview

A review of existing literature on crowd flow from areas such as travel behaviour (CTS), collective animal behaviour (Dr Ana Sendova-Franks of Engineering Design and Mathematics) and complex systems theory (Dr. Alison Hooper and Dr. Jan Van Lent of Engineering Design and Mathematics), will concentrate on identifying testable hypotheses and investigate the feasibility of a multidisciplinary research project. We will focus on:

(1) *Manipulative experiments* - crowd flow control requires an understanding of the dynamical link between individual and collective behaviour, but social interactions are notoriously difficult to study in humans. Certain social insect colonies lend themselves to manipulative experiments (e.g. traffic flow in nest channels during nest emigration in rock ants);

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(2) *Modelling of social interaction* – this has been done mainly through individual-based simulations. To analyse and generalise the results of such models, and set experiments correctly, we need mathematical modelling. A natural source is fluid dynamics. However, there are differences between fluid and crowd flow, existing equations have to be modified and methods for incorporating social interactions identified; and

(3) Relevance to human behaviour and the design of public spaces.

Varied Expertise

This project will apply multidisciplinary expertise to the above aims. CTS will provide expert knowledge on travel behaviour and modelling and biomimetic search techniques. Partners will contribute with expertise in collective animal behaviour, experimentation and statistical modelling, fluid dynamics, numerical methods for solving partial differential equations and agent-based modelling.

Output Goals

A research paper on the multidisciplinary review of existing literature carried out during the project will follow and support a seminar presenting findings in early 2011.

We will identify gaps, key terms and papers, establish research potential and modelling feasibility, and give a flavour of genetic questions.

Our main output will be a review which will (1) bring together the different approaches and methodologies from our respective fields; (2) identify novel and testable hypotheses; and (3) evaluate the feasibility of new experimental and mathematical modelling methodology.

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