Herds, Troupes and Posses: Implicit Interactions with Groups of Robots

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Abstract
In order to design gestures and movements for machines that are meaningful and socially appropriate, we have been studying the way that people interact in plazas, sidewalks and street intersections. One important aspect of public interactions is interactions with groups. Sometimes people walk in pairs, sometimes people walk in small groups, and sometimes we encounter large entourages, parades or mobs of people. Typifying and modeling these types of implicit group interactions can be as important for a robot on the street as knowledge of one-on-one interactions. In this paper, we describe some of the group pedestrian behaviors we have observed and discuss the implications for human-robot interaction.

Author Keywords
Groups; Implicit Interactions; Public Interactions; Autonomous Cars; Design

Introduction
In William H. Whyte's Secret Life of Small Urban Spaces, Whyte marvels that how pedestrians crossing Seagram's Plaza in New York move quickly and smoothly yet never run into one another [6]. When we contemplate making mobile robots and devices that can perform these same passing interactions with pedestrians, these mundane maneuvers become remarkable. Roboticists tend to look at

collision avoidance with pedestrians as a motion planning and prediction problem [10], but we know from our own experiences on the street that these maneuvers are as much about low level signaling and communication–implicit interaction [5]–as planning and prediction. What signals do people make that machines must pick up on? What actions should the machine make to make their own intents known?

In order to design gestures and movements for machines that are meaningful and socially appropriate, we have been studying the way that people interact in plazas, sidewalks and street intersections. This is a pre-cursor to field experiments to test how robots might employ the non-verbal communication patterns used by people to better negotiate busy public spaces. This research is aimed at providing insight on the unspoken rules that govern physical interaction in public spaces, but also what information and tools interactants need to engage properly in these non-verbal exchanges.

While social scientists often focus on passing pedestrian interactions occurring between individuals (see Goffman [2], Ingold [4], Wolff [7]) or as larger groups whose behavior approaches fluid or Brownian motion (see [3]), we can observe in our day-to-day on-the-street interactions with people in groups that the lived experience is somewhere in between. Sometimes people walk in pairs, sometimes people walk in small groups, and sometimes we encounter large entourages, parades or mobs of people. Typifying and modelling these types of implicit group interactions can be as important for a robot on the street as knowledge of one-on-one interactions. In this paper, we describe some of the group pedestrian behaviors we have observed and discuss the implications for human-robot interaction.

Project description

Our project has focused on walking environments, ”spaces dominated by pedestrian movement, where other modes including motor vehicles may have a place, but where pedestrians clearly have movement priority.” [9] To make more explicit what we all implicitly understand about socially appropriate public interaction, we have been observing interaction patterns in a variety of public pedestrian contexts. We believe that at the interpersonal level, there is low-level coordination and signaling that enables collision avoidance [1] and coordination between people that might be critical for mobile robots deployed in public to understand. We follow up our observational studies with field experiments, employing an experimental protocol that uses a hidden operator to simulate an autonomous robot (in the manner of [8]) to test naturalistic human-robot interactions in the field. We are particularly experimenting with how variations in movements and physical signaling might be used to signal and negotiate intended movement, particularly with groups of interactants, and with specific group members.

Reflections on Groups

For the purpose of discussing interaction patterns, we are developing an taxonomy of movement and interaction. Focusing on groups, it is important that we understand that pedestrian groups might be organized in different ways, and these groups are likely to respond differently to events.

Herds

Herds or flocks are groups of people who organize like a group of animals. Their behavior is emergent, coming out of the accumulated individual behaviors of group members following simple rules. Large bands of people who have only recently become affiliated–members of a bus tour, for example, or groups of children in a summer camp–tend to move in herd-like fashion.

One of the interaction consequences of herd groups is that the interaction is *amorphous*: any interaction with an individual of the group should produce roughly similar behaviors. Larger herds can be divided into smaller herds which should still obey basic herd rules. Herds tend to have a high level goal and general sense of how to move towards it, but they behave in response to contexts and events tactically rather than strategically.

Troupes

Troupes are groups that are organized. Their behavior is strategic and planned, and all the members of the group know the plan. People who have long been affiliated or who have rehearsed their movements–like a military battalion, a marching band, or more casually, people in a parade, children marching two-by-two–tend to move in a concerted fashion which is readily distinguished from herd behavior.

Troupes often behave in a way that is *crystalline*: rigid, regular, and a little brittle. The response of troupes to interactions depends a lot on whether the specific interaction was anticipated. Troupes can start and stop in unison; members are alert to one another as well as the higher level plan, and are constantly coordinating. However, troupes are often thrown into disarray if something surprising occurs.

Posses

Posses behave in a way that is different than troupes and herds because they involve groups of people who are all defined relative to a central member. This entity, whether a leader (think, Jesse James and his band of outlaws) or an unwilling participant (think, celebrity surrounded by paparazzi) , is essential to the behavior of the larger group. All the members of a posse keep their attention and focus on the central member, and only minimally attend to one another.

When interacting with posses, it is important to identify the central member and address interactions to that member, since the others do not have a meaningful impact on the behavior of the larger group.

Conclusion

Generalizing beyond the specific concerns of our project-in-process, we believe an important task in the consideration of groups in human-robot interaction is developing a broader taxonomy of groups based on how they will respond interactively. We should be asking whether there is symmetry in the classification of groups of humans and groups of robots, or if they should have separate social hierarchies and arrangements. More importantly, we should strive to understand through research and design what kinds of group arrangements demand which kinds of designed interactions, so that we might better design group interactions for people and robots that are safe, fun and socially acceptable.

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