Analysis of pedestrian behavior in individual and group displacements

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Abstract

Many of our actions are influenced by the social context, in particular, by the actions carried out by other people. Within pedestrian flows, people tend to walk in groups such as friends, couples, or families. In this sense, an important aspect that needs to be analyzed is the influence of the relationship between the properties of each person and the collective properties resulting from the social interaction between people. The main goal of this work is to develop a methodology to acquire and analyze empirical data about the movement (characteristics of the gait and speed) and pedestrians' actions (distance, spatial formation), through the realization of field experiments before and during road crossings in urban areas using wearable inertial sensors and video recordings.

Author Keywords. Pedestrian behavior, Social interactions, Pedestrian groups, Gait parameters

1. Introduction

The study of pedestrian behavior is essential for the proper planning and design of different types of urban infrastructures. The use of models is a tool that can support transport engineers in managing pedestrian flows. The purpose of any simulation package is to model the characteristics and the interaction of all elements of a system to accurately predict what will happen if a situation changes. It is therefore necessary to try to maintain the rationality of each individual without neglecting the identification of the preexisting social structures (pedestrians' groups) and their interaction within a crowd. According to previous works, the gait parameters provide higher capability of distinguishing how the pedestrian respond to different types of interactions, since pedestrian speed alone may not be adequate (Hussein and Sayed 2015).

2. Materials and Methods

Information about pedestrians' behavior isolated and within in a group is being collect through the realization of field experiments before and during the road crossing in urban areas. Video recordings of each experiment will allow calculate pedestrians' trajectories and speeds through using a semi-automated tool for video processing (T-Analyst 2014). Additionally, one pedestrian will be instrument with a system for a human wireless motion tracker– Xsens MTw Awinda (Paulich et al. 2018). This tool will allow the collection of gait parameters (e.g. step frequency, step length) and also the speed (Figure 1).

The pedestrians' groups will be organized according to: the size of the group (2 and 3 members), the gender (women, men and mixed), the age (between 18 and 44 years old) and the difference between height of the group members in three levels: (i) lower than 3cm, (ii) between 3 and 7cm, (iii) more than 7cm.
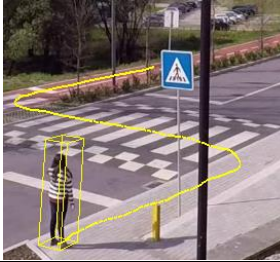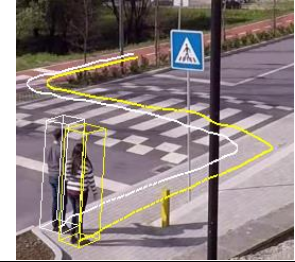
Gait parameters	Analysis with semi-automated tool for video processing		
Equipement	Isolated pedestrian	Isolated pedestrian	Pedestrians in group

Figure 1: Example of materials and methods

3. Discussion

The analysis of pedestrian behavior in individual and group displacements is intended to describe in a more rigorous way the behavioral responses of pedestrians due to social interactions, given their ability to adapt movement in response to stimuli of other individuals. Thus, to determine new parameters that will define the internal coordination between the members of the same group.

4. Conclusions

There is a need to better understand the pedestrian behavior to enhance existing pedestrian simulation models. To study human behavior, video recordings of the pedestrians' flows in a public place are used, however, the exact conditions of individual characteristics and interactions between people are generally unknown, for example: age, psychological profile, motivations, restrictions or relationships between people. Therefore, a more controlled approach should be used regarding this observation types.

References

Hussein, Mohamed, and Tarek Sayed. 2015. "Microscopic pedestrian interaction behavior analysis using gait parameters." *Transportation Research Record: Journal of the Transportation Research Board* (2519):28-38.

Paulich, Monique, Martin Schepers, Nina Rudigkeit, and Giovanni Bellusci. 2018. "Xsens MTw Awinda: Miniature Wireless Inertial-Magnetic Motion Tracker for Highly Accurate 3D Kinematic Applications." *Xsens: Enschede, The Netherlands*.

T-Analyst. *Software for semi-automated video processing*. Lund University 2014. Available from www.tft.lth.se/video/co-operation/software/.

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