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Pedestrian fuzzy risk exposure indicator

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Abstract

We all find ourselves in the situation of a pedestrian at least for a short period of time. The loss of millions of lives and injury of others, is not enough sufficient for urban architects, decisions makers and designers to radically reconsider the design of the urban network, and not only improve the use of pathways and priorities rules, but to improve the walking environment for pedestrians while considering walking as an essential and necessary part of the overall transportation system. Without protection, pedestrians are particularly vulnerable network road users. The reduction or elimination of risks to pedestrians is an important and achievable goal. In this paper we present an indicator of pedestrians' accidents risk which can evaluate the accident rate on a chosen network road.

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Keywords: virtual pedestrian model; intelligent agent; simulation; accident risk; transportation theory

1. Introduction

The development of the urban network relies heavily on the study of the movement of its users, including their interactions. Urban planners and decision makers focused on improving road use for vehicles, while neglecting the needs of the most vulnerable road users are pedestrians. Fortunately, in recent years, researchers have focused on studying the interaction of movement between pedestrians and vehicles in order to predict and prevent accidents. Note that the movement of pedestrians is subject to less stress compared to that of vehicles in terms of traffic rules. However

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the study and analysis of the movement of pedestrians and their interactions with the components of the urban network will allow planners to understand their behavior and reactions to various strategies, interventions or better yet, a better facility planning can ensure a suitable level of safety. However, the dynamics of pedestrians and the complexity of decision-making in different situations cannot be easily modeled using algebraic equations, but are processed by simulation modeling. Indeed, the latter has through several researches identified several characteristics of pedestrian traffic, but is criticized for its lack of explanatory power necessary to exploit the results in planning and road engineering Papadimitriou (2012). Moreover, the study of the dynamics of road users is a key objective of avoiding collision between them. Even if the accident results represent malfunction of the road system, they are still both predictable and preventable. The collision avoidance process involves, for both road users, three essential steps that begin with the analysis of the environment and the detection of the object (vehicle or pedestrian), the decision depending on the situation current and avoidance action Llorca et al. (2011). Within this context, this paper presents a measurement of an accident risk indicator based on both safety stopping time for a vehicle and pedestrian crossing time. These two parameters are considered as fuzzy numbers as they are not deterministic and remain imprecise for pedestrians and vehicles. This paper is structured as follows. After a short introduction, section 2 presents some related works. The third section presents the concept of fuzzy modelling and some relevant definitions. Section four presents the fuzzy ant pedestrians model using artificial potential fields. Later section five presents pedestrians exposure to accident risk and the calculation of the accident risk indicator. Finally we present obtained results and relatives discussions, and later we give a conclusion.

2. Related works

Faced with a navigating problem to a chosen destination and following an own motivation, pedestrians explore their environment and carry out a way to begin planning. These individual decisions are usually determined by a research moving utility maximization. This behavior is also observed in the choice of routes crossing paths. And of course, guaranteeing the maximum comfort possible running. This behavior qualified optimal, is not explicitly thought, but it is learned after testing and personal or perceived errors in others. This Allows pedestrians to automatically learn to use the most appropriate driving behavior in standard situations. Several simulation models of the dynamics of pedestrians and their interaction with vehicles during road crossing have been developed in the literature. This section presents a partial list. These models can be classified according to several criteria namely the level of detail studied behavioral, time discretization, the nature of movement rules, etc. To respect the context of this paper, only research works treating dynamic interaction of both road users will be addressed in this section. Saravanan and colleagues present an accident prediction approach based on fuzzy logic. Their study evaluates the accident risk for pedestrians as well as vehicles and meet the accident zones on a given road network Saravanan et al. (2014). The growth in the number of pedestrian-vehicle accidents led Lu and Noyce to develop a micro simulation approach has several alternatives indicating pedestrian crossings mid-block with various geometries. Their study is to examine the effect of changing signage and geometry on the crossing process from the perspective of both road users Lu and Noyce (2009). Works given in Lassare et al. (2007) develop an approach of accident risk based on the concept of risk exposure used in environmental epidemiology, such as in the case of exposure to pollutants. Research that have been developed by Meira et al. (2015) relate to the recognition of children in dangerous situations. The child-pedestrians are more susceptible to failure in identifying hazardous situations. To better understand capacity development risk perception in dynamic situations of the road. Works proposed by Meira et al. (2015) examined the detection capabilities of the dangers by child-pedestrians in a virtual environment. Gaps in Understanding child-pedestrians in assessing traffic situations contribute to the effort to produce intervention techniques that can increase their attention to the potential risks and lead to the reduction of their over-involvement in accidents. The work presented in Harsh et al. (2014) analyzes the various parameters related to pedestrian crossings behavior taking into account the gap acceptance. The developed solution estimates the possibilities of accepting a given gap or delay while considering different parameters which affect pedestrian crossing behavior. This study revealed that the age of the pedestrian is the most important variable in the behavior of crossing over other parameters studied. Furthermore, in a macroscopic logic, the tool VISSIM was used by Bergman and his colleagues to simulate the dynamics of pedestrians at roundabouts and evaluate the performance of these latter Bergman et al. (2011). By adopting a meso-micro modeling approach, Liu and his