

SAFEPED: Agent-Based Environment for Estimating Accident Risks at the Road Black Spots (Demonstration)

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ABSTRACT

The data on traffic accidents clearly point to the "Black Spots", where the accident rate remains high in months and years. However, road safety research is still far from understanding why this certain place on a road is risky. We tackle the problem by developing SAFEPED, multi agent microscopic 3D simulation of cars' and pedestrians' dynamics at the black spot.

Categories and Subject Descriptors

I.6.5 Computing Methodologies, Simulation and modeling, Model Development

General Terms

Algorithms, Design, Reliability, Experimentation, Human Factors, Standardization

Keywords

Traffic accidents, Black Spot, agent-based modeling, spatially-explicit modeling

1. INTRODUCTION

Police data on the number of traffic accidents clearly point to the "Black Spots", where the accident rate remains high in months and years. However, road safety research is still far from understanding why certain road locations are risky.

Essentially, we lack the knowledge of how pedestrians and drivers interact when facing a potentially dangerous traffic situation and, most important, the integrated framework that relates the data on human behavior to the real-world traffic situations.

So far, road safety is studied with the general purpose traffic simulation models extended towards including conflict statistics. This approach, however, is inherently limited. The dynamic road safety model should incorporate the variables that are critical for road incidents but superfluous for simulating general traffic: the characteristics of mechanical and functional characteristics of vehicles and in-vehicle systems and, especially, the rules of drivers' and pedestrians' behavior, including drivers and pedestrians' awareness and reaction to each other [1].

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We present safety oriented high-resolution spatial micro-simulation model of car and pedestrian traffic that enables direct simulation of the road accidents and associated risks.

2. SAFEPED simulation environment

To represent the dynamic reality at the Black Spot and merge it with the experimental data on drivers' and pedestrians' behavior we have developed SAFEPED - Multi-agent environment for spatially explicit microscopic 3D simulation of the Black Spot dynamics.

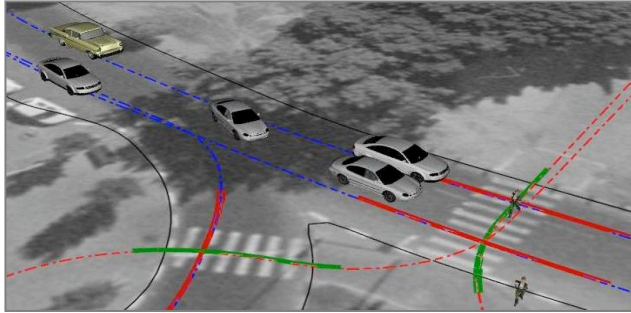
SAFEPED serves as a testbed for evaluating experimentally estimated drivers' and pedestrians' behavioral rules and estimating accident risks in various traffic situations. It aims at analyzing disadvantageous environmental design at the Black Spot and assessing alternative architectural solutions there.

The major features of the SAFEPED are as follows:

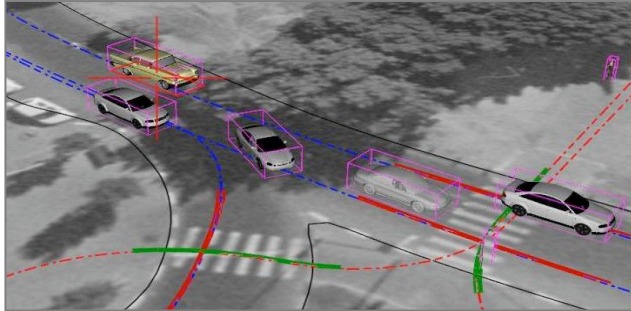
- SAFEPED agents are autonomously behaving pedestrians and drivers who see and estimate the 3D-movement of the other agents and react in response once in 0.04 sec;
- SAFEPED agents see each other in 3D and behave based on the 3D visibility
- The user defines the properties and goals of movement of the drivers and pedestrians participating in the traffic episode;
- The rules of agents' behavior are based and validated based on the analysis of video footage captured at the places of drivers-pedestrian interaction.

During the simulation, SAFEPED records the full life-history of every agent, including all crash and near-crash episodes. The user can analyze the crash and near-crash statistics, rewind and replay the simulation starting from any moment of time, observe accidents from various viewpoints, including the viewpoints of the crash participants (Figure 1). The user can also intervene into the model dynamics by taking control over one or more agents. To analyze accident risks SAFEPED applies indicators describing the conflicts between traffic participants, such as Time-to-Collision and Post Encroachment Time [2].

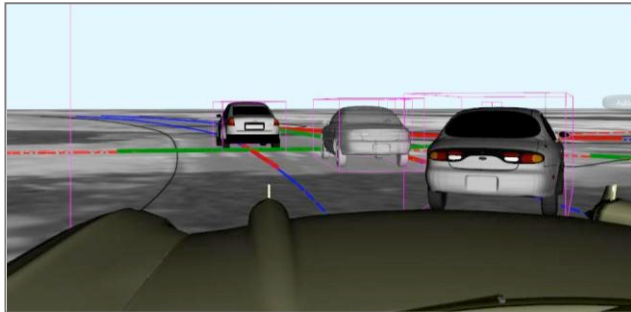
The paper presents the SAFEPED and results of investigation of several accident scenarios. See general view of the SAFEPED at <http://www.youtube.com/watch?v=ia3W8oiTVYw&feature=related>, formalization of visibility at <http://www.youtube.com/watch?v=6KFcfFRElt8&feature=related>, and illustration of traffic accident at <http://www.youtube.com/watch?v=axWEGNetpM0>



a



b



c

Figure 1. SAFEPAD traffic episode: (a) agents participating in the episode; (b) visibility of the other cars for chosen agent; (c) visibility of the other cars from the viewpoint of the chosen agent

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