Will Ubiquitous Eco-driving Increase Environmental Impact?

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Background

Eco-driving is a driving style that offers many benefits, including greenhouse gases emissions reductions, fuel cost savings, as well as greater safety and comfort. The emission reduction effect of individual eco-driving is now clearly understood. However, what will the impact of ubiquitous eco-driving be, where everyone is driving in an eco-friendly way? Recently, some traffic engineers doubt the positive impact of ubiquitous eco-driving and even claim that emissions will increase due to slowing of traffic and increased traffic congestion.

Objective

To investigate such questions related to eco-driving behavior, we developed BeGreen, a 3D multi-user driving challenge space, which provides incentives to users for practicing eco-friendly driving. The goal of this research is to provide large-scale behavioral driving data which will allow traffic engineers to draw valid conclusions on ubiquitous eco-driving. We developed a novel incentive mechanism that automatically adapts the difficulty level for eco-driving, so that drivers feel challenged over extended periods of time, and hence create important behavior data for the traffic engineers.

The BeGreen Multi-user Eco-driving Tool

Users compete in a virtual Tokyo to see who is the best eco-driver

Challenge is adapted automatically to each driver’s performance, to keep them interested over time

Driving data for Traffic experts

DIVE: massively multiuser networked 3D virtual world technology

DIVE logging component

Core Technology: Incentive Mechanism using Dynamic Challenge Balancing

(1) Calculate challenge

(2) Adjust desired difficulty

If too difficult: decrease
If too easy: increase

(3) Identify users affected by opponent

For Traffic Light T1

User 1

User 2

are affected

(4) Get desired action for each user

For User 1: 1st optimal action
For User 2: 3rd optimal action

(5) Check conflicts

a₁: Turn red on last moment
User 1

User 2

conflict!!
a₂: Stay green

(6) Choose action that minimizes impact

Impact indicates previous measures of challenge increase/decrease per user

Impact table (user X action)

(7) Update impact

Recalculate challenge and check difference from previous:

\[ e'_1 - e_1 \]

\[ e'_2 - e_2 \]

(1) Calculate challenge

Users compete in a virtual Tokyo to see who is the best eco-driver

Incentive to eco-drive by presenting challenge to players

e.g. 1: Traffic lights manipulation

e.g. 2: Aggressive computer-controlled cars

And others!

DiVE: massively multiuser networked 3D virtual world technology

And others!