RFIDを活用した自動車運転支援・情報提供システムの構築に関する研究
RFID-based vehicular system for driving assistance and information providing

富樫 宏謙(Hiroaki Togashi)　　山田　茂樹(Shigeki Yamada)

何がわかる？

カーナビゲーションシステムなどに「今どの車線にいるの？」「目的地はどの車線上にあるの？」という車線ごとの情報を載せることができます。

We aim at implementing lane-based information on car navigation system. Lane-based information is such that “Which lane my car is going on?”, “Which lane the destination is on?” etc.

どんな研究？

RFIDを路面に設置することにより、「今自分の車はどの車線にいるの?」という情報を収集し、それに基づいて車線ごとの情報を提供したり、レーンキープアシスト機能を実現するプラットフォームの構築を研究しています。

This research tries to retrieve ”Which lane my car in going on?” by possessing RFIDs on road surface. And based on this information, we are researching on how to construct “lane-based information providing system”, “lane keeping assistance system” etc..

どのようなことに役立か

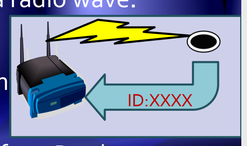
現在のGPSを利用したカーナビゲーションでは道路構造の複雑な個所ではうまくナビゲーションを行うことができませんが、RFIDを活用してカーナビゲーションシステムを構築することで、目的地へのナビゲーションで走行レーンを指示することが可能になります。また、同じプラットフォームでレーンキープアシスト機能を実現することもできます。

Current navigation system based on GPS(Global Positioning System) sometimes cannot correctly define path in case that road structure is complicated etc.. Navigation towards to a destination can operates “which lane driver should run on” by constructing car navigation system based on RFID scheme. Also, lane keeping assistance system can be achieved on the same platform.

研究状況

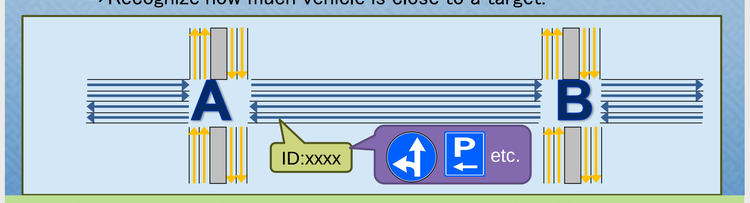
What is RFID?

- Radio Frequency Identification
  - Communicates Information as ID, Via radio wave.
- Types of RFIDs
  - Classification by method of operation
    - Passive type
      Emits radio wave with power supply from Reader.
    - Active type
      Emits radio wave by own battery,.
  - Classification by wave range
    - LF/HF/UHF/Micro wave



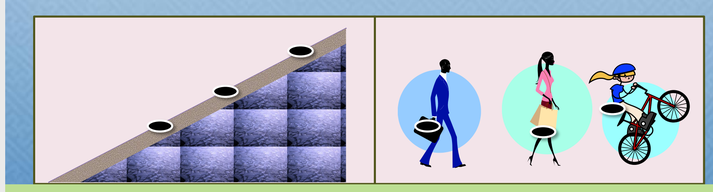
Concept

- Achieving information providing system for vehicle by RFID Schemes
- Obtaining ID from RFID
  ⇒Using this ID, vehicle can access to the information (Where is the entrance to a parking, which direction this lane can go etc.).
- Measure distance between vehicle and an RFID
  ⇒Recognize how much vehicle is close to a target.



Concept

- Achieving vehicle–to–roadside and vehicle–to–pedest rian clash avoidance system by RFID Schemes
- Obtaining ID from RFID
  ⇒Using this ID, vehicle can access to the information. In case of ro adside, “going direction of the road” etc.
- Measure distance between vehicle and an RFID
  ⇒Recognize how much vehicle is close to a target.



“Vehicle-to-Roadside” avoidance system

☼We define avoidance operations consisting of…

Braking \ Steering	None	Small Degree	Large Degree
None	Lv.0	Lv.1	excluded
Soft Braking	Lv.1	Lv.2	Lv.3
Hard Braking	excluded	Lv.3	Lv.4

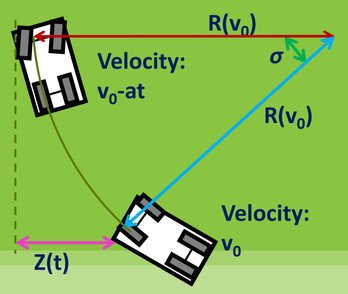
☼In order to avoid large degrees of steering and hard braking as much as possible, the combined operations have a higher priority than single operations.

☼Thus, we define five levels of avoidance operations.

“Vehicle-to-Roadside” avoidance system

☼Model of avoidance operations

☼Displacement Z(t) for each operations is solved as follows.



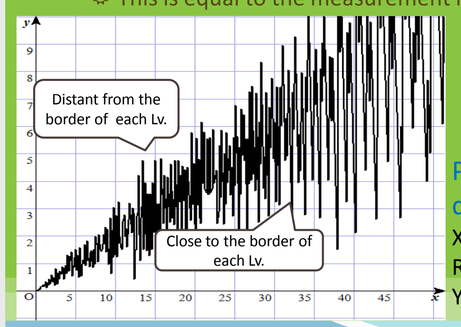
Displacement Z(t) for Braking with deceralation “a” and Steering with Rotation Radius R(v_0) equals…

$$Z(t)=R(v_0)\left(1-\cos\frac{2v_0t-at^2}{2R(v_0)}\right)$$

“Vehicle-to-Roadside” avoidance system

☼In case that distance between each RFIDs is within 5m, the sum of delay becomes less than 1-second.

☼This is equal to the measurement interval in GPS.



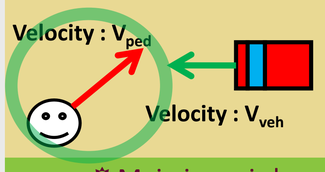
=>enough accuracy

Plots of the sum of delay (one part)
X-axis : distance between RFID
Y-axis : sum of the delays

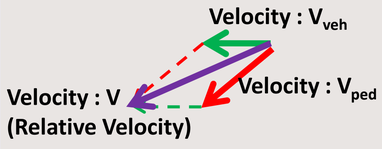
Enhancement for “Vehicle-to-Pedestrian” avoidance

☼Concept is based on “Relative velocity” between vehicle and pedestrian

Absolute Velocity



Relative Velocity



☼Main issue is how to estimate pedestrian’s movement.

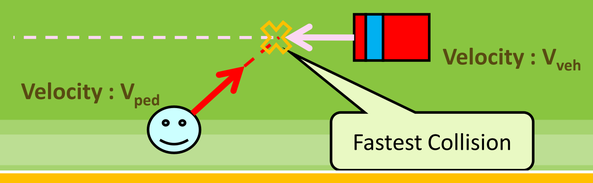
Enhancement for “Vehicle-to-Pedestrian” avoidance

☼Proposed model

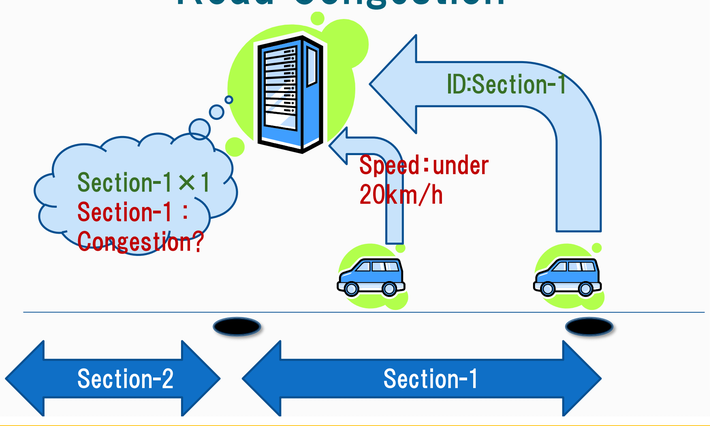
☼In order to make probability of avoidance become 100%, We propose “Simplest model”

☼This model only considers “worst case”(Fastest Collision in Figure)

☼Amount of calculation is reduced



Information Providing system for Road Congestion



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シミュレータの作成

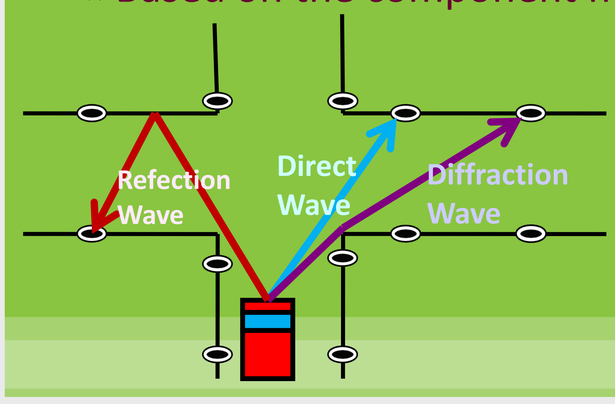
現在、有効性の確認と課題の抽出を目的としてシミュレータの実装を進めています。Visual C++による実装が本研究での中心ですが、これと並行してSecond Lifeをベースとするシミュレーションツール Open Sim上でのシミュレーション実装がPrendinger研究室との共同プロジェクトにより進行しています。

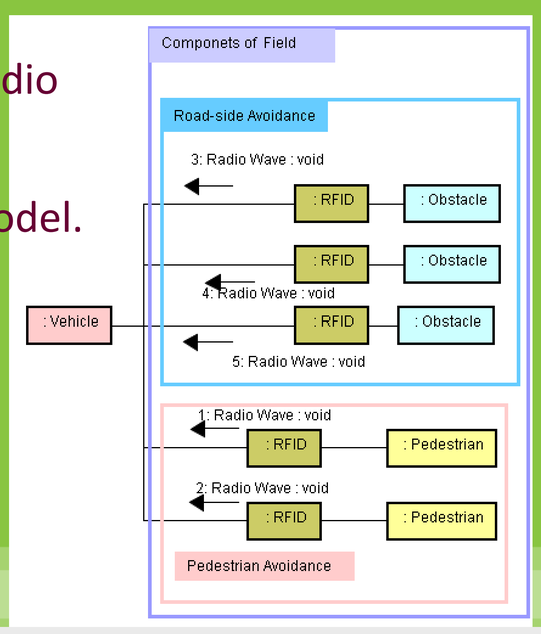
Currently, Simulator related to this research is on-going. The aim of this simulator is verification of this system and extraction the issues to be solved before practical use of this system. Main platform in this research is Visual C++. In parallel, implementation of simulator on “Open Sim”, which is the simulation tool based on “Second Life” is on-going with the cooperation of Prendinger Lab..

研究状況

Implementation of simulator

- Concept of this simulator is…
  - Supporting some types of radio wave.
  - Based on the component model.

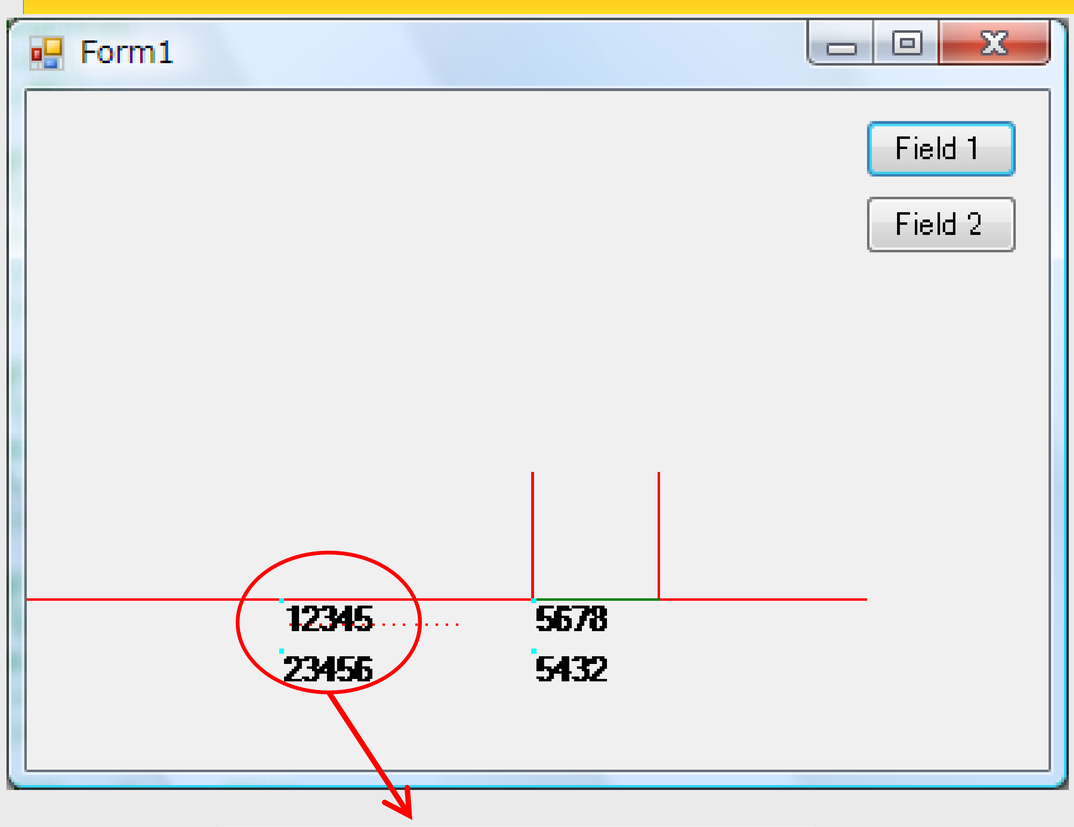


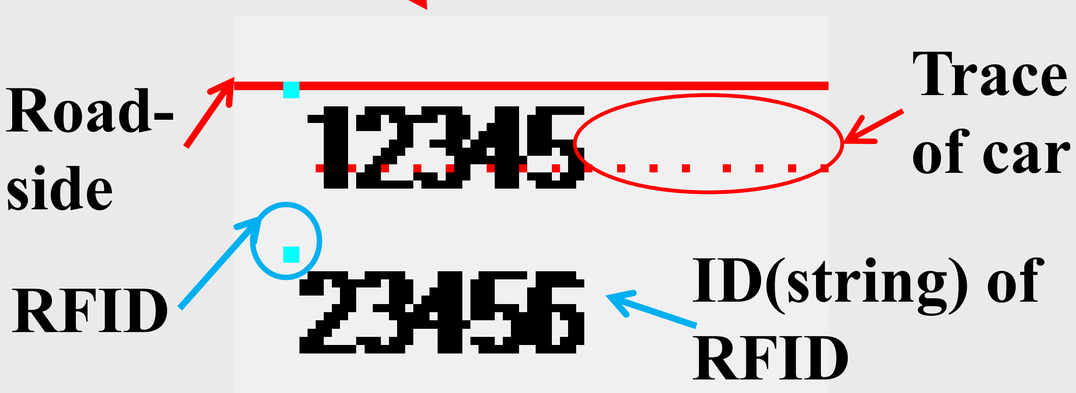


Implementation of simulator

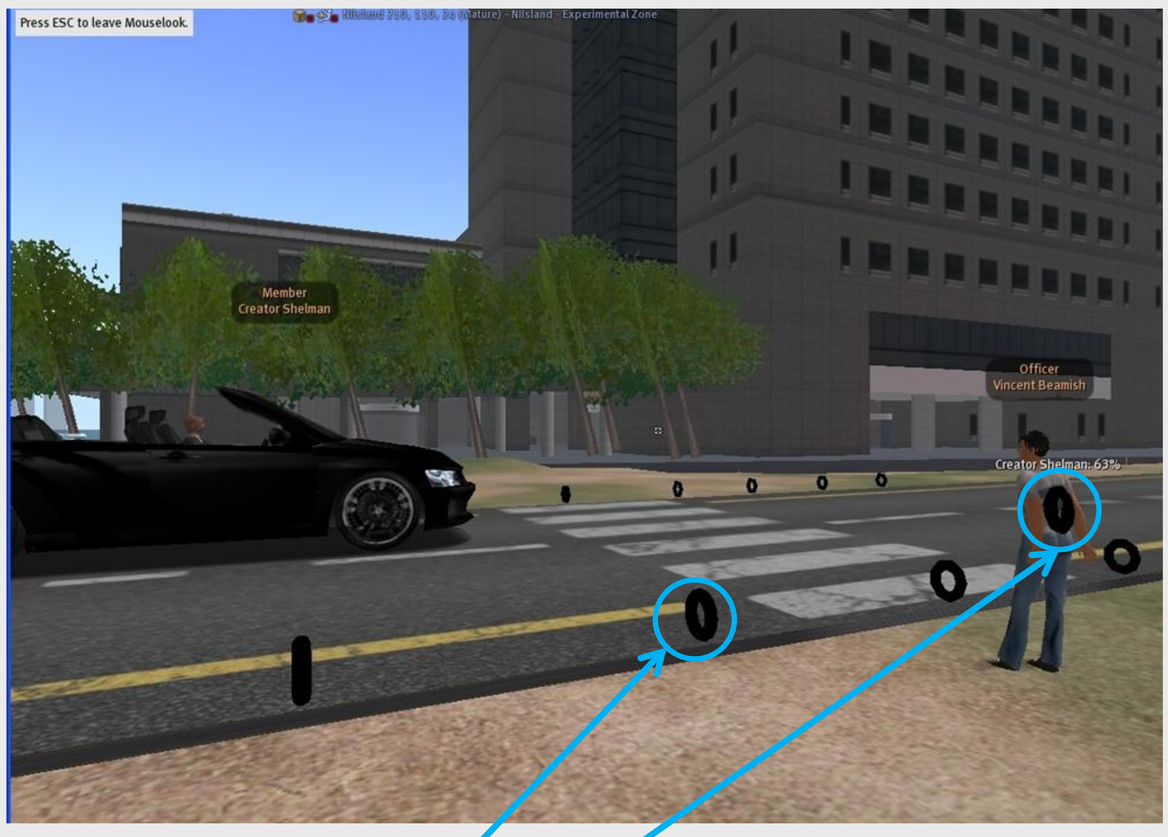
- Evaluation will be done by examining trace of car.
- Through this simulation…
  - Functionality of this system is verified
  - Some unexpected results may occur.
- Illegal results indicates…
  - The failures of clash avoidance
  - The unnatural movement of vehicle caused by this system.

スクリーンショット(C++)





スクリーンショット(Second Life)



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