Bicycle simulator based on UC-win/Road

FORUM8

11th CPWC Skiller

Background

Cycling as a Means of Mobility

Rising bicycle mode share in response to **modern city issues**. ⇨ traffic jams, land use, energy consumption, air pollution, climate change, physical inactivity...

Increasing Traffic Conflicts

Growing number of vehicles on the roads leading to more **traffic conflicts** between cyclists and vehicles. ⇨ WHO report shows that pedestrians, cyclists, and motorcyclists account for more than half of global road traffic deaths.

Understanding cyclists' behavior in different design contexts is crucial for improving bicycle safety.
To understand cyclists' behavior in different contextual settings, we developed a bicycle simulator.

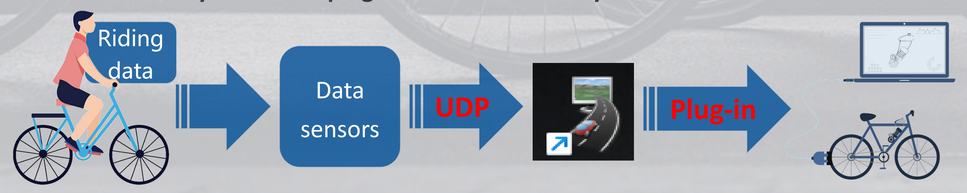
It can help to:
1. Develop robust cyclist-focused datasets
2. Model bicycle dynamics
3. Evaluation of cyclists' behavior
4. Study the environmental determinants of cyclists' behavior.

Introduction of the bicycle simulator

By using a bicycle simulator, users can ride in a virtual scene by riding in place and implement the following operations.
The bicycle simulator consists of simulation software and plug-ins (UC-win/Road 15.1), a bicycle, a wireless router, four data sensors, and an image display screen.

Data sensors (Bicycle: Mormanton iThink Neway 7.0 RD folding bike)	
1. Rear brake sensor	Brake data of rear wheel Millan KS8 miniature built-in spring self-reducing displacement
2. Angle sensor	Direction data H6 Haval F5F7VV6VV5 Angle sensor
3. Front brake sensor	Brake data of front wheel Millan KS8 miniature built-in spring self-reducing displacement sensor
4. Speed sensor	Speed data Witt Intelligence JY901S

System Flow
1. Users cycle to generate movement data
2. Sensors collect data
3. The sensors are connected to UC-win/Road 15.1 through the User Datagram Protocol (UDP).
4. UC-win/Road 15.1 uses the bicycle control plug-in to control the bicycle movement in the virtual scene.



Operation method of the bicycle simulator

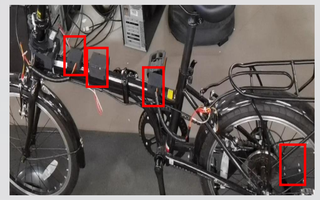
1. Connect network & Turn on sensors
Turn on the **router, four sensors and PC**
Make sure the router and the sensors are connected to one router (**Same IP address**)

2. Open the scripts (Delphi)
Open and run the delphi script BikeControlPluginMain.pas"

3. Evoke UC-win/Road
UC-win/Road 15.1 will automatically open
Select the scene file, and load the simulated road scene.

4. Connecting sensors
The sensor data will be transmitted to the UC-win/Road
Click on the "SDK Plug-in"
Select "Bike Control"
Check the sensor connection status

5. Start riding
The subjects began to ride, and could try steering, U-turn, accelerating, sliding, braking and other actions.
The simulator will simulate the real riding action in terms of vision and body sense.



Advantages of the bicycle simulator

Immersive cycling experience
- ✓ Realistic sight
- ✓ Vivid sound
- ✓ Motion sense

Customized virtual scenes
- ✓ Simulate different road traffic environment (Traffic scenes, weather, day/night)

User-friendly and Interesting
- ✓ High operability,
- ✓ Wide application scenes
- ✓ Low cost of use

Convenient data output
- ✓ Collect and output motion information at different times (Speed, direction, position)

Future work

Connection to VR devices
Obtaining a more immersive bicycle riding experience in virtual scenes.
Capturing **the experimenter's eye tracking data**, allowing for a deeper study of rider behavior.

Experiments in the field of traffic safety research
Experiments on interactions and conflicts between road traffic participants can be designed and carried out, which is considered expensive and risky in field research.

Developing cluster systems
Through an online platform, **multiple experimenters** can interact **in the same traffic scene**. More applications, such as driver loop research, automatic driving algorithm simulation test, road collaboration/intelligent network vehicle simulation test would be supported.