

Simulators and simulator usage, 6 hp 729A63 (Ht 2013)

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Introduction

This document provides some useful information concerning the simulator you will use in this course. Both Jonas and I can provide additional information if needed. You will also get practical information on how to start and run the simulator. However, the aim of this document is to give you enough information to start the planning of your project. Use the template when planning, when you have a first draft we will discuss it before you continue. We need to make sure that what you plan is realistic and feasible within the course.

Project work

The idea is that you will focus on formulating a research question and hypothesis, set-up an experimental design, conduct, analyze data and report a small-scale simulator study. In this document, you will find some available scenarios, situations, functions etc. that you can use (with help of Jonas, who will do the necessary programming). Your projects should be presented in a report and orally. Furthermore, you will review and comment another group project. Reports from previous group projects will be available on the course website.

Hardware

The simulator is a commercial driving simulator developed for driver training. It is developed by the German company Dr.-Ing Reiner Foerst GmbH. The simulator comes with Foerst's own simulation software, but it has also been adapted to use VTI's own simulation software. The simulator consists of a car cabin (based on a Ford Focus), a simple motion system, three 40 inch LCD screens, and a surround sound system. All the usual driver inputs are available, i.e. steering wheel, pedals, gear stick, dashboard. The motion system is not used together with VTI's software. The road environment is rendered on the screens in front of the driver, including rear view mirrors.



Figure 1 Foerst F-10 simulator

Software

The simulator is controlled by one computer, the kernel, while more computers are used to render the images and play the sound. The computers are standard desktop PCs, running Windows XP/7/8 or openSUSE Linux. The simulation is divided into several software applications, each responsible for its own part of the simulation. The kernel software controls the scenario (surrounding vehicles, etc.), runs the vehicle model, and sends updates to other computers, see figure below.

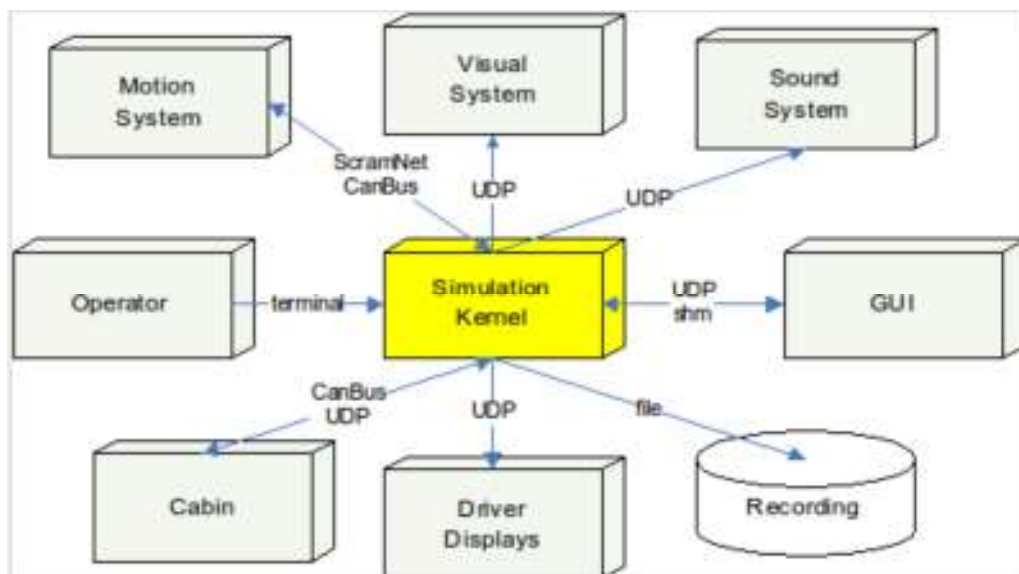


Figure 2 VTI simulator architecture

Road environments

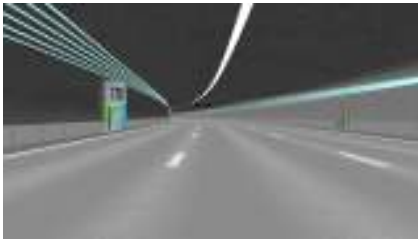
These are samples of road environments available in VTI's simulators. Most of these road can be connected to each other and modified to suit your project, e.g. adjust road length and width, change speed signs, etc. For live demonstrations, talk to Björn or Jonas.

Motorway 1: Model of E4 northbound from Linköping to Norrköping. Two lanes, ca 40 km. Contains a road work near the end.



Motorway 2: Model of E4 northbound from Nyköping to Södertälje. Two lanes, ca 60 km. Contains several entry and exit ramps to which other roads can be connected.

Tunnel: Model of Förbifart Stockholm (Stockholm Bypass). Three lanes, ca 20 km. The tunnel cannot be connected to any other road.



Rural road: The same road (same geometry) can be run in three different configurations, forest, open fields, and snowy forest. Ca 10 km per configuration.



Road through small town: Skeda. Ca 3.5 km. Varying speed limits between 30 and 70 km/h.



The four environments above can easily be connected to one continuous road, i.e. 4x10 km.

Straight road: 10 km. Suitable for manoeuvring tests.



Töllsjö: Narrows and twisty rural road, ca 15 km.



Town: Small town environments. Contains three and four-way junctions, both with and without traffic lights, and one lane roads inbetween. Road may include bus stops and parking. Roads and junctions can be connected to form arbitrary town environments. It is possible to turn in junctions.



Driver support systems

Front Collision Warning (FCW): Warning sound if the driver is at risk of colliding with a vehicle in front, e.g. if the vehicle in front brakes hard.

Lane Departure Warning (LDW): Warning sound if the driver change lanes unintentional, e.g. if the driver is distracted.

Vehicle dynamics

Front/rear wheel drive: You can easily change between front wheel and rear wheel drive during runtime.

Automatic/manual gear box: It is possible to use the simulator with automatic or manual gear box. This cannot be changed during runtime.

Friction: Road friction can be adjusted during runtime. Can be used to simulate snow or ice roads.

Traffic and other actors

There are two types of traffic in the simulator:

- Simple autonomous vehicles which are generated at certain intervals and then drive by themselves.
- Controlled traffic where everything is programmatically controlled (velocity, etc.).

It is possible to use cars, buses, trucks, and tractors. We also have pedestrians, cyclists, and mooses.

Events

Sample events:

- **Car braking in front**
- **Car overtaking**
- **Cone tracks:** Double lane change and slalom maneuvers.
- **Junctions:** In the junctions in the town, it is possible to control traffic lights and to have cars entering and exiting.
- **Road works**

Environment

- **Fog** can be added to the environment, and the density can be controlled.
- **Snowfall**, with varying density, can be added.

Measurements

This is a sample of measurements available from the simulator. Anything (almost) in the simulation can be measured.

- Distance driver
- Lateral position and heading on road
- Velocity

- Acceleration
- Rotational velocity
- Steering wheel angle
- Throttle input
- Brake pedal input
- Left/right indicators
- Gear
- Engine revs and torque
- Velocity and position of other actors (vehicle, pedestrians, etc.)
- Distance to other actors
- FCW/LDW warnings
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