# OPENDRIVING: AN OPEN SOURCE DRIVING SIMULATION SOFTWARE

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**Abstract –** This paper presents an open source driving simulation software that is platform-independent, research-oriented, distributed and soft body physics-based. It has formal and standard scenario/world description, goal-driven autonomous virtual drivers and rigid body-based simulated vehicles. It is designed to be a tool and test-bed for areas that require realistic and controllable traffic environment, such as game development, driver training, human factor research, nanoscopic traffic simulation.

**Key words:** Driving Simulation, Automated Planning, Temporal Reasoning

## 1. Introduction

The driving simulation software equipped by driving simulators can be regarded as scenario generators, because a scenario covers the physical world, the traffic flow, simulated vehicles' interactions with the participant's vehicle and measurements that need to be collected. Due to its complexity, the driving simulation community still needs to work on some shortcomings of present simulation platforms regarding 1) un-realistic entity representation, 2) manual traffic flow manipulation and 3) platform-dependent controlling of simulated vehicles. As a result, an open source project, termed as OpenDriving, was initiated based on a framework SOAV (Scenario Orchestration with Autonomous simulated Vehicles), whose mechanism has been described in [Xio1] and [Xio2]. Its rendering part has been implemented with an open source vehicle simulator RoR (Rigs of Rods, http://www.rigsofrods.com/content/).
OpenDriving has the following features:1) C++-based cross-platform design; 2) SOAV-based, research-oriented framework; 3) Ontology-based, human-readable, machine-processable, data scheme for describing scenarios; 4) Distributed architecture for networking and extension; 6) Realistic soft body physics and 7) Rich resources from the community of Rigs of Rods and SUMO [Kra1] if necessary. The OpenDriving project will be opened to public during the Driving Simulation Conference 2014 in Paris (4-5 September 2014) via Google Code (https://code.google. com/p/opendriving/).

This short paper will provide an overview of the architecture of OpenDriving.

## 2. OpenDriving Description

As illustrated in Figure 1 on Page 2, OpenDriving has the following components:

1) The Ontology for Scenario Orchestration: this ontology is used to describe scenarios and relevant driving context for a virtual driver in a formal, context-oriented, programming-independent, logic-based, human-understandable and machine-processable manner; more information can be found in [Xio3] and [Xio4].

2) Simulation Platform: In previous research, the basis of OpenDriving - SOAV - has been tested with simulation platforms from the University of Leeds [Xio1, Xio2] and VTI [Xio5]. In OpenDrving, Rigs of Rods was used in order to have a soft body engine to simulate realistic vehicle bodies and objects;

3) The Virtual Driver: The Virtual Driver will carry out driving activities based on scenario requirements from the Ontology for Scenario Orchestration, which can include the actions needed to produce interactions and corresponding context, e.g., braking (action) as a leader (context); The simulated vehicles in the Simulation Platform will be controlled;

4) Traffic Flow Manipulator: Equipped with SUMO, the Traffic Flow Manipulator will produce traffic flow with predefined travel

demands; the generated vehicles will be visualized in the Simulation Platform if they are near to the human participant's vehicle (it has been set as 1500m around the participant vehicle);

5) Scenario Observer: this module monitors the packages transmitting on the network during simulation and extra interfaces can be provided to users through desktop or hand-held devices.

## 3. Conclusions and Future Enhancements

OpenDriving, as a modular framework, can provide a tool or test-bed with realistic physics and behaviours to users, who can range not only from serious game players to academic researchers, but also from driving instructors to simulation developers. It can help entities ranging from individuals to agencies. For instance, a scenario with a car crash in an intersection can be used to simulate the C2C (Car to Car) communication module in vehicles. The crash information will be transferred to several (simulated) human participant's vehicle before they can see the crash. The crash will be visually simulated in the intersection with the help from Rigs of Rods. Moreover, a scenario for human factor research with controllable vehicle behaviours can be constructed with a traffic flow generated by the Traffic Flow Manipulator with pre-defined characteristics such as traffic flow rate. As a first attempt of gathering knowledge in the community, OpenDriving is believed to serve its purpose and be useful, and extra efforts from the whole community are anticipated in the near future.

## 4. References

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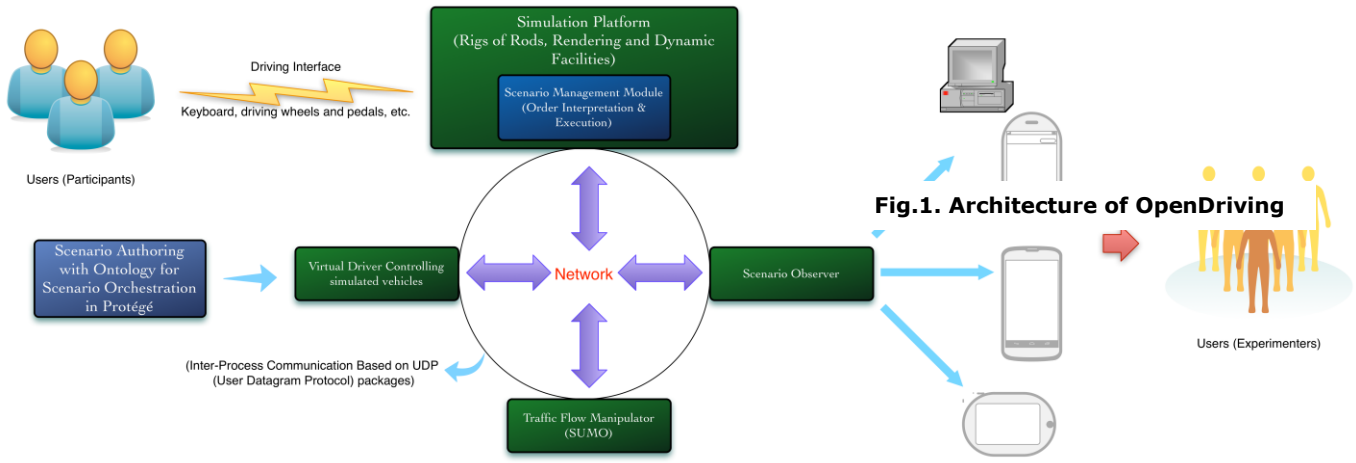


**Fig.1. Architecture of OpenDriving**

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