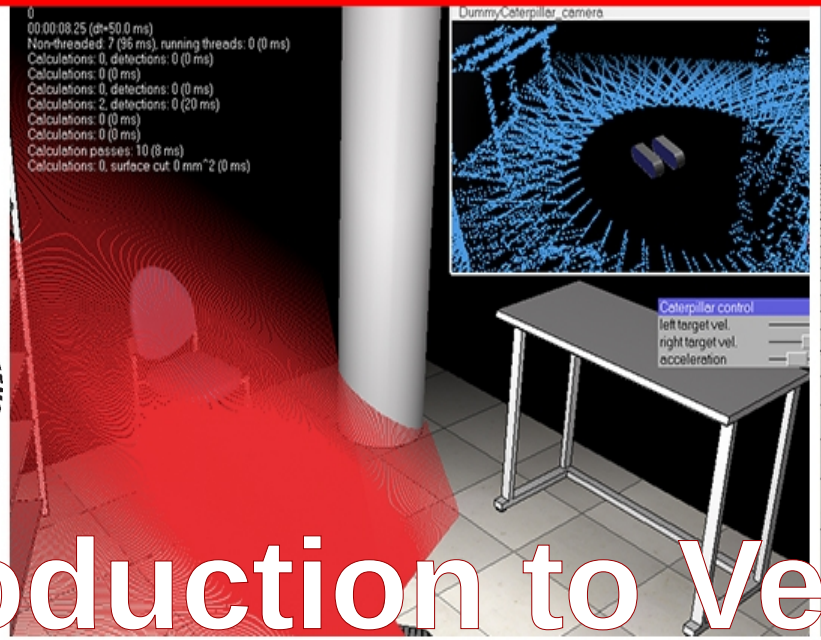
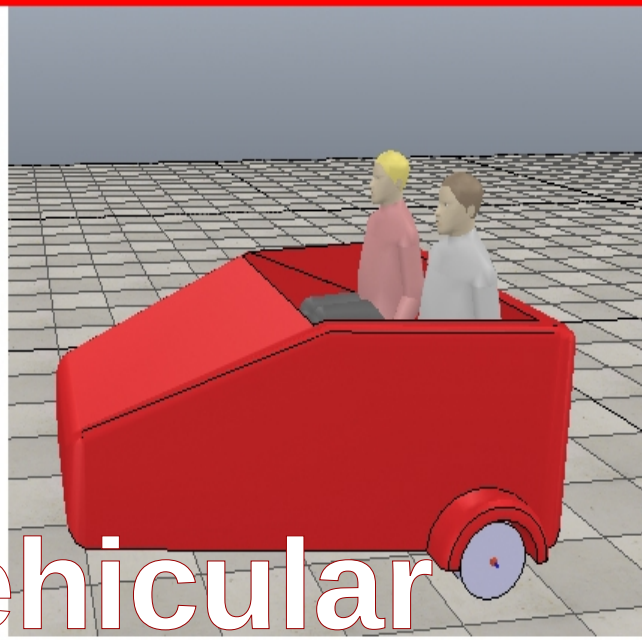
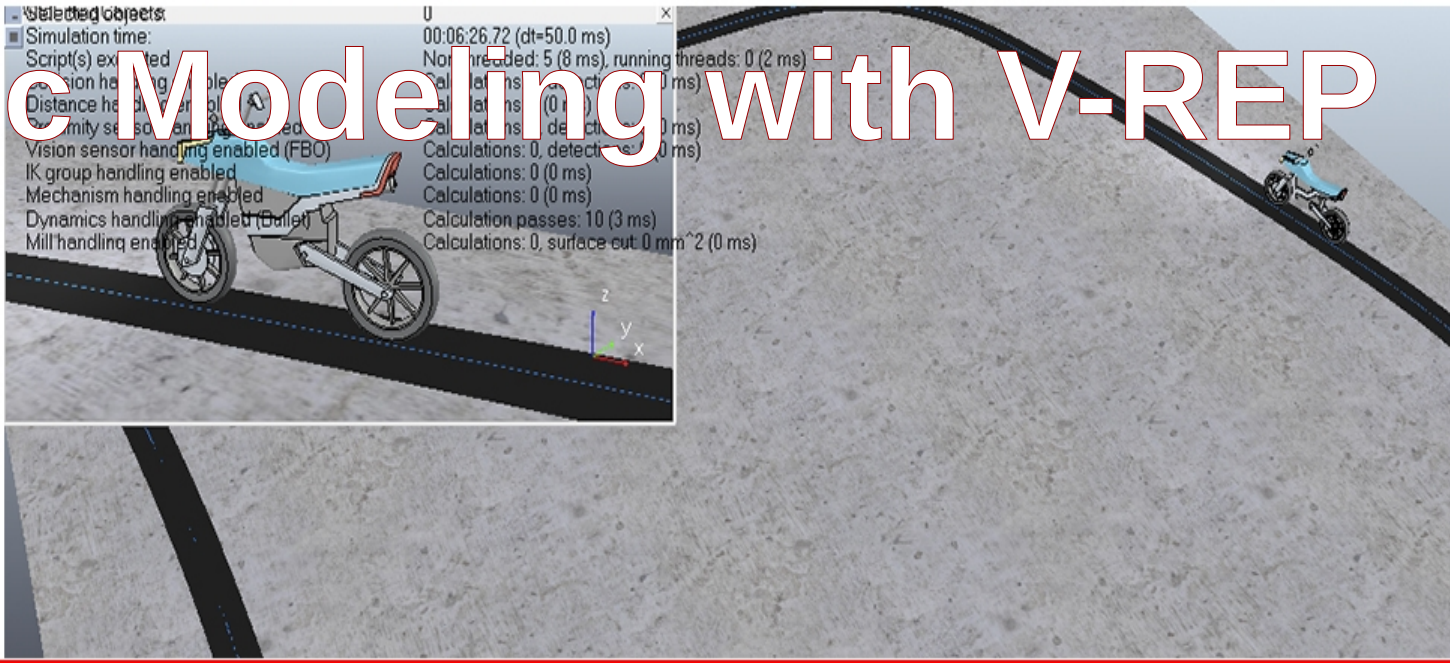
Introduction to Vehicular Robotic Modeling with V-REP







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ABSTRACT

Nowadays modelling and simulation are essential tools in most of engineering fields. V-REP (Virtual Robot Experimentation Platform) defined itself as “the Swiss army knife among robot simulators” and thanks to its many features is called to be a reference weapon in intelligent vehicles development. This course introduces the simulator and it basic operation focusing on the multiple applications in this area. After the course, the student will be able to start it owns projects using this software. The main outcome of this course is an initial knowledge of the simulator features and possibilities.

INTRODUCTION. COURSE OVERVIEW

V-REP is a powerful cross platform (Windows, MacOSX, Linux) robot simulator full of functions
and features and 7 programming languages compatibility (C/C++, Python, Java, Lua, Matlab,
Octave and Urbi). To mention interesting vehicular simulation features:

- 4 physics engines (ODE, Bullet, Vortex, Newton)
- Mesh-mesh interference detection
- Mesh-mesh minimum distance calculation
- Path / motion planning (holonomic in 2-6 dimensions, non-holonomic for car-like vehicles, and motion planning for kinematic chains)
- Vision sensors with built-in image processing (fully extendable)
- Realistic proximity sensors (minimum distance calculation within a detection volume)
- Built-in custom user interfaces, including editor
- Dynamic particles for water-/air-jet simulation

The goal of this course is to introduce the audience into this software. Thus, the delegate must not have any prior knowledge on this software. The methodology is very similar to a Massive Open Online Course (MOOC), in which delegates may follow their own pace.

COURSE STRUCTURE

Week 1. Introduction. 15' video plus quiz.
The main features of the simulator will be introduced and it operation will be explained to be prepared for start the modelling. Licencing; download, installation and execution; scenes and models; pages, views and custom user interface; Objects; and scripts.
Week 2. Modelling of a vehicle. 15' video plus quiz.
Using the concepts introduced in the previous topic, a basic vehicular model creation will be explained and this model will be used in the following topics. It will basically consist in primitive shapes insertion and parameterization, mess importing, object/item translation and position scaling operations, joint attaching and object hierarchy management to build a three-wheel car.
Week 3. Configuring sensors. 15' video plus quiz.
One of the most interesting features that V-REP provides us is the capability simulate realistic proximity and vision sensors which are customizable and can be attached to the models providing information that can be processed in or out the simulator (API). It features will be shown in this topic.

COURSE STRUCTURE

Week 4. Including sensors. 15' video plus quiz.
In this topic the possibilities of the mention feature will be exploited in our vehicular model in order to provide autonomy adding one vision sensor and two proximity sensors.
Week 5. Paths configuration. 15' video plus quiz.
New object will be discussed. It simply defines a trajectory in space but it can be used for path planning or as target for guidance. It will be used to guide our model.
Week 6. Introduction to remote API, connecting V-REP and MATLAB. 15' video plus quiz.

V-REP offers a remote API allowing to control a simulation from an external application or a remote hardware. The V-REP remote API is composed by approximately one hundred functions and in this topic, some of them will be called using MATLAB to illustrate how the API can be set and how it works, reaching and sending information from and to our vehicle model.

COURSE INSTRUCTORS

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Carmelo Aurelio Mena García is PhD candidate at the University of Las Palmas de Gran Canaria, under the supervision of Prof. Sanchez-Medina. He's studying the use of V-REP for modelling personal automated vehicles in closed environments.

His interests as a researcher are sustainable engineering, electric autonomous vehicles and personal assistance focused engineering.