A Visual Overview of the SSTSS-GenSim Tool Workflow

Step-by-Step Guide to the SSTSS-GenSim Tool

The **SSTSS-GenSim Tool** facilitates scenario-based simulation and testing for ADS. SSTSS-GenSim comprises seven modules: Scenario Selection, Implementation, Configuration, Integration, Data Collection, Safety Metrics Evaluation, and Data Visualization. Each module corresponds to specifa ic stage of the scenario-based safety testing pipeline, collectively forming a unified testing tool for evaluating the safety performance of ADS. In this tutorial, we provide a step-by-step guide for using the SSTSS-GenSim tool. To demonstrate its applicability, we consider a use case UT-ADS. This tutorial refers to Section 5 of article.

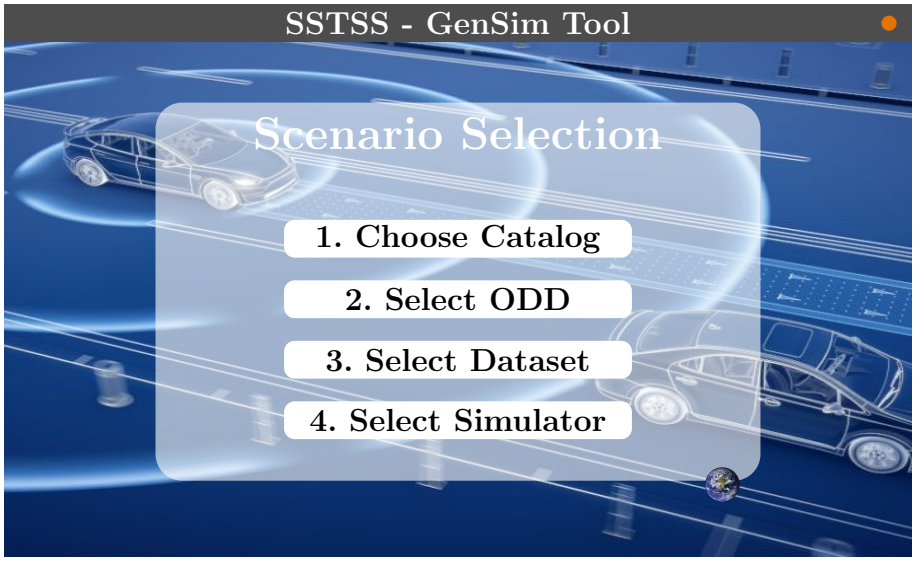


Figure 1: Graphical User Interface for the Scenario Selection Module

For Scenario Selection Module, users provide four inputs.

Step 1: Choose Catalog: Select the appropriate scenario catalog. The current version includes two default catalogs: *Singapore* and *NHTSA*. For demonstration, the Singapore Catalog is selected. Users can also add new scenarios by clicking the *Add Scenario* button and selecting the catalog to which the scenario should be added. Additionally, users have the option to create custom catalogs.

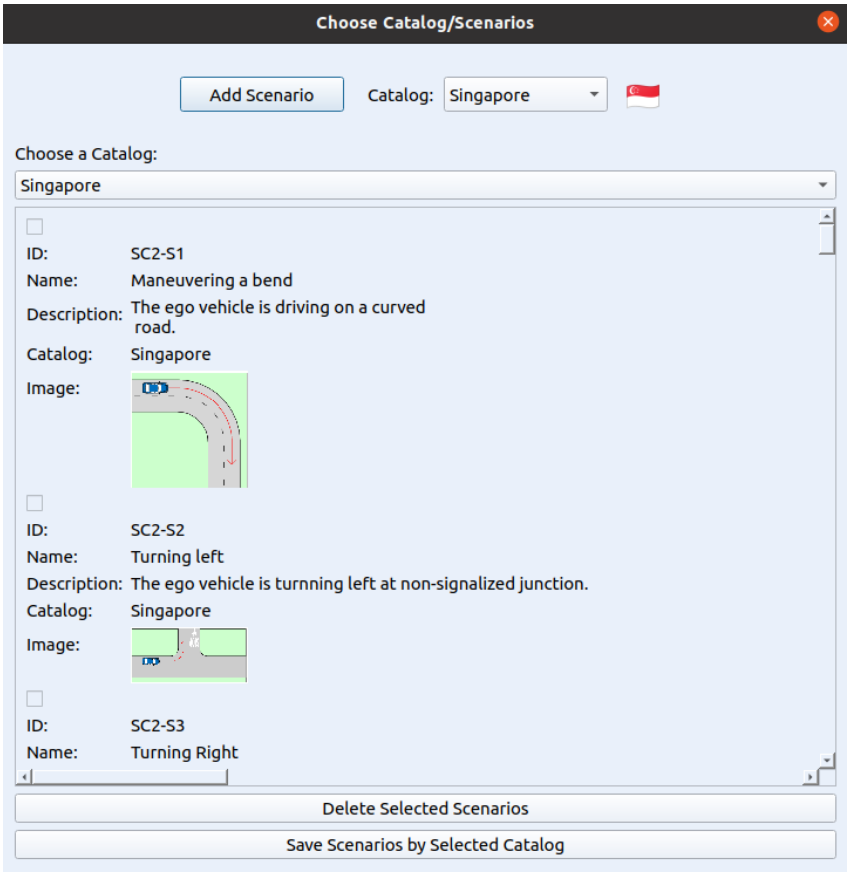


Figure 2: Choose Catalog window

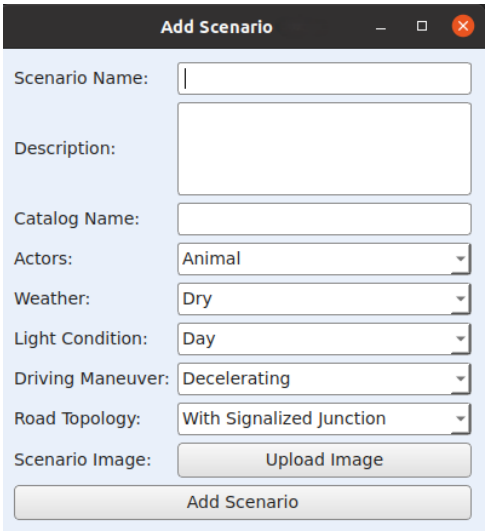
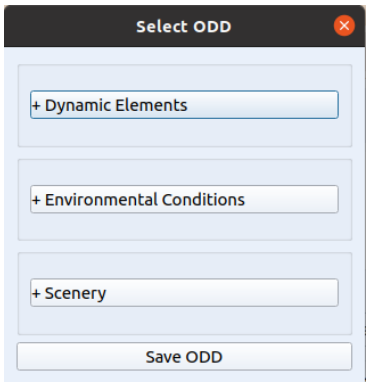
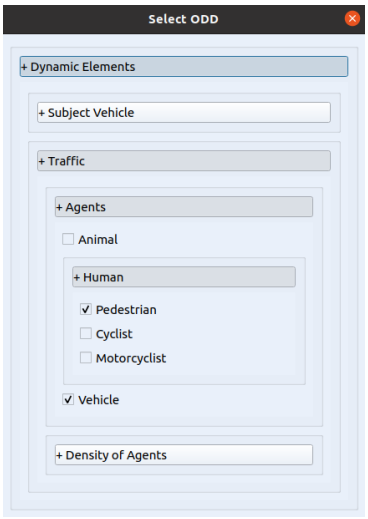


Figure 3: Add Scenario Interface

Step 2: Select ODD: Configure the Operational Design Domain (ODD). The ODD setup comprises three modules — *Dynamic Elements*, *Environment*, and *Scenery*. Each tab can be expanded to specify ODD elements. Each tab in the ODD configuration can be expanded to define specific ODD elements. For the demonstration, we select the ODD parameters based on the operational capabilities of the UT-ADS.

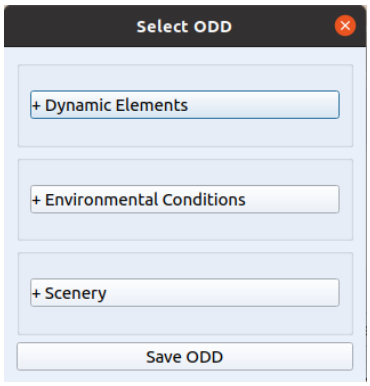


(a) ODD Input

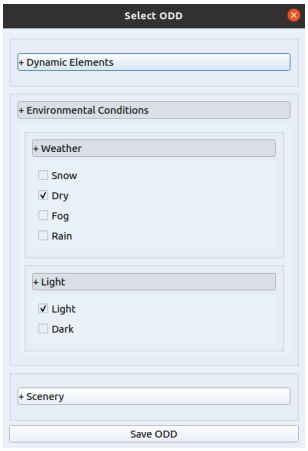


(b) Dynamic Elements

Dynamic Elements: Under **Dynamic Elements**, we selected *pedestrians* and *vehicles*, as the UT-ADS is capable of detecting and interacting with both.



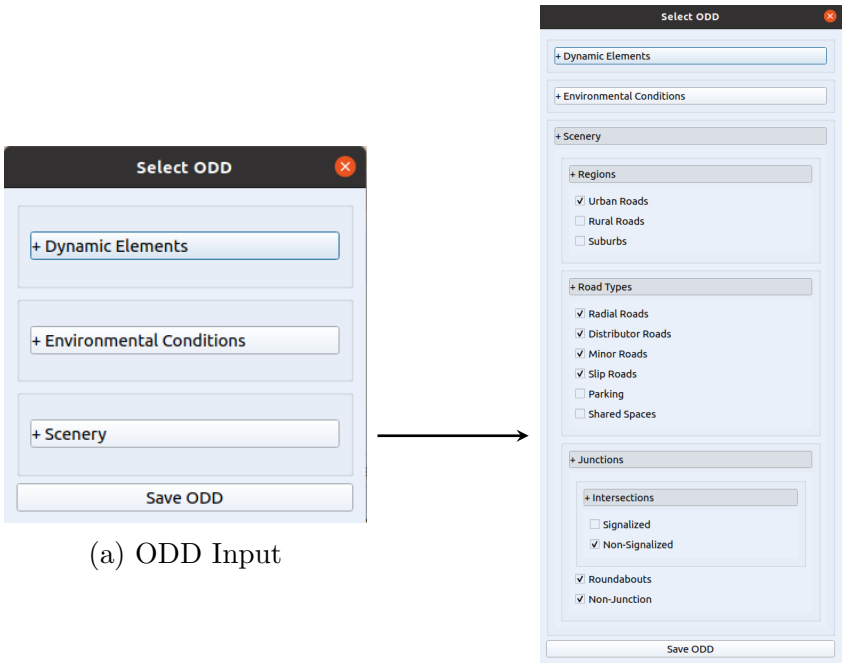
(c) ODD Input



(d) Environmental Conditions

Environmental Conditions: We configured the scenario for *daytime* with *dry weather*.

Figure 4: Process flow for ODD configuration across Dynamic Elements and Environmental Conditions.



(a) ODD Input

(b) Scenery Elements

Scenery Elements: We selected an *urban road environment*. The road type was defined as *radial*, including slip roads, minor, and distributed roads.

Figure 5: Process flow for ODD configuration (continued): Scenery Elements.

Step 3: Select Dataset: The tool allows users to select dataset. Currently, two datasets are supported; For demonstration, the US Accident Dataset is selected.

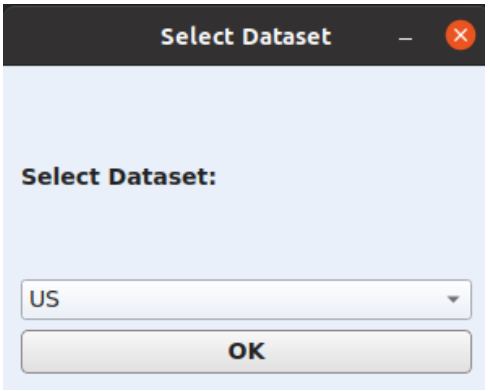


Figure 6: Dataset selection interface

Step 4: Select Simulator: The tool allows users to select simulator, the current version supports CARLA.

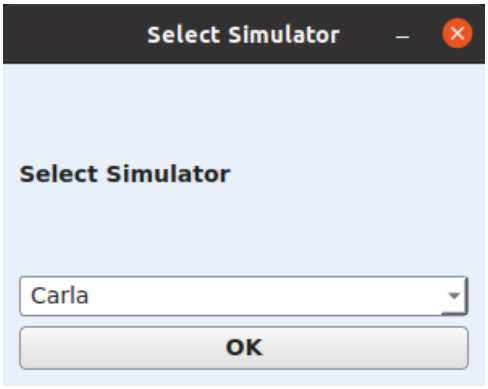


Figure 7: Simulator selection interface

Final Output: Upon giving four inputs, the tool generates a structured list of selected scenarios, including their IDs, names, descriptions, and preview images.

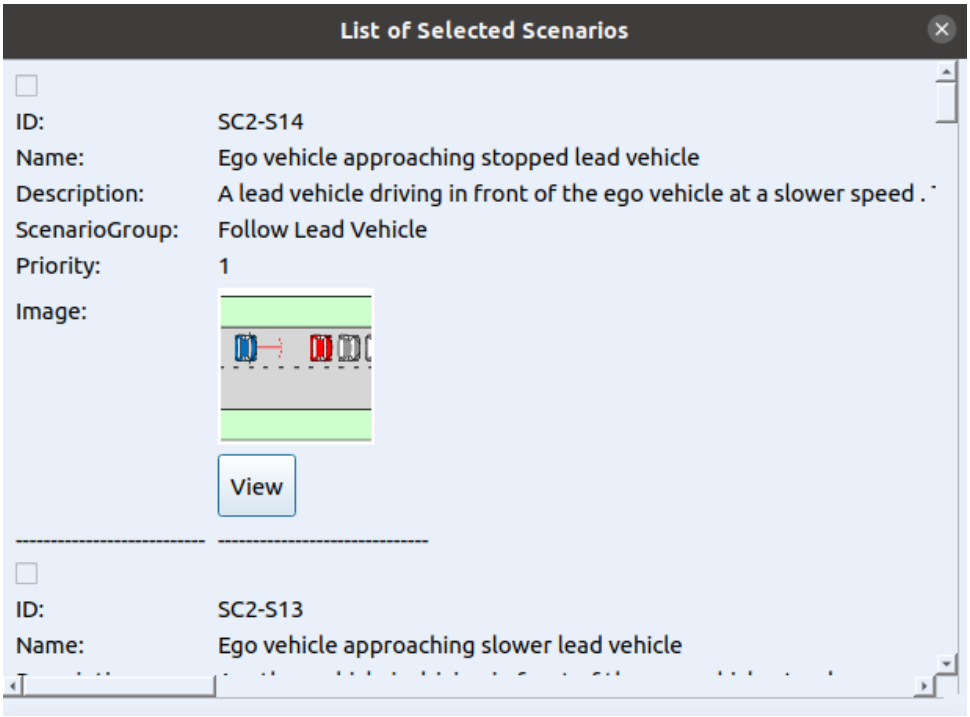


Figure 8: Final list of selected scenarios

Step 5: Once the scenarios are selected, the tool automatically converts the top prioritized scenario into executable `FollowLeadVehicle.py` files for the simulator. No user interaction is required for this step.

Step 6: Scenario Configuration: Selecting *View* opens a configuration window where users can modify scenario parameters before execution. For demonstration, we configure the parameter shown in the figure below.

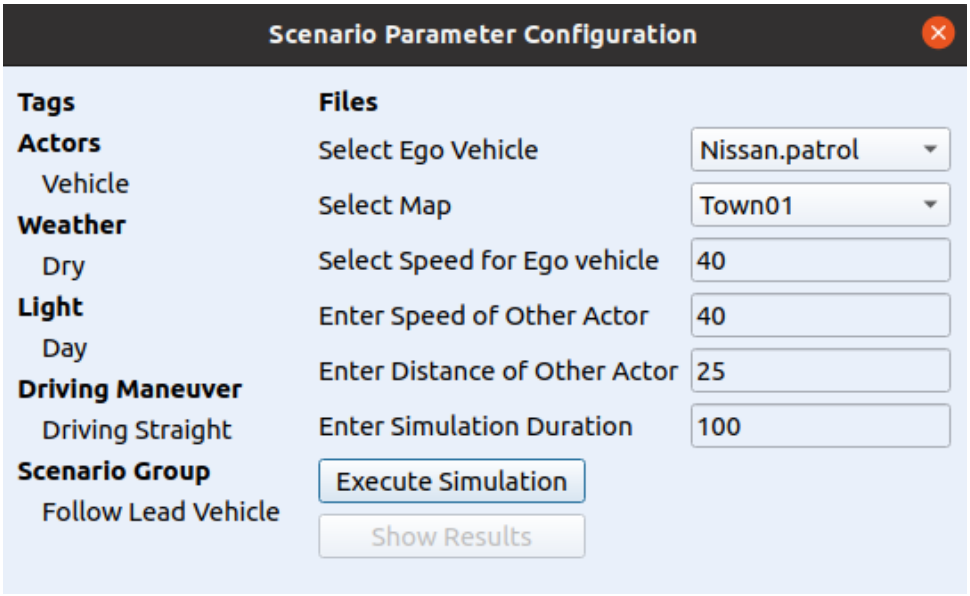


Figure 9: Scenario parameter configuration interface

Step 7: Once the parameters are congifured, the tool generates `FollowLeadVehicle.xml` files for the simulator. No user interaction is required for this step.

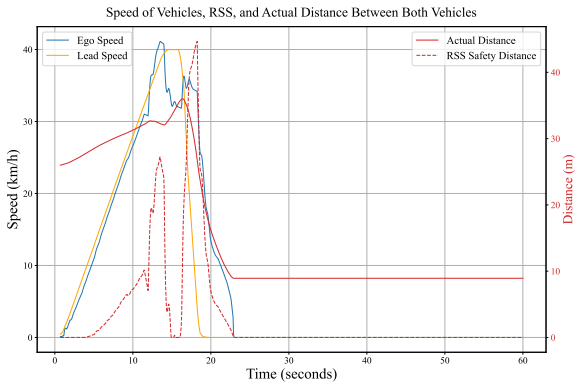
Step 8: Scenario Execution: Upon pressing *Execute Simulation*, the configured scenario is executed in the chosen simulator. The system visualizes both the CARLA simulation view and the RViz perception view.

(a) CARLA view (b) RViz view

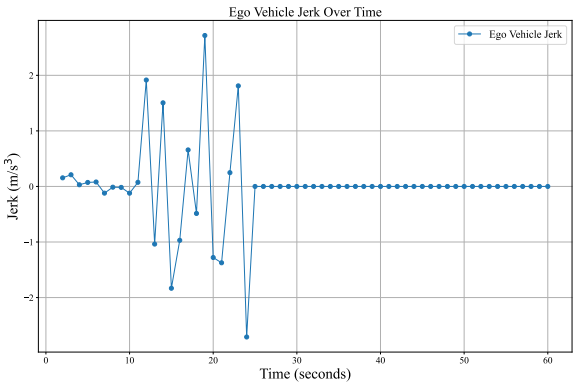
Figure 10: Scenario execution in CARLA and RViz

Step 9: Once the simulation is finished, the tool automatically, the tools calculates three safety metrics: (i) Collison Avoidance,(ii) RSS Minimum Safe Distance and,(iii) Jerk.

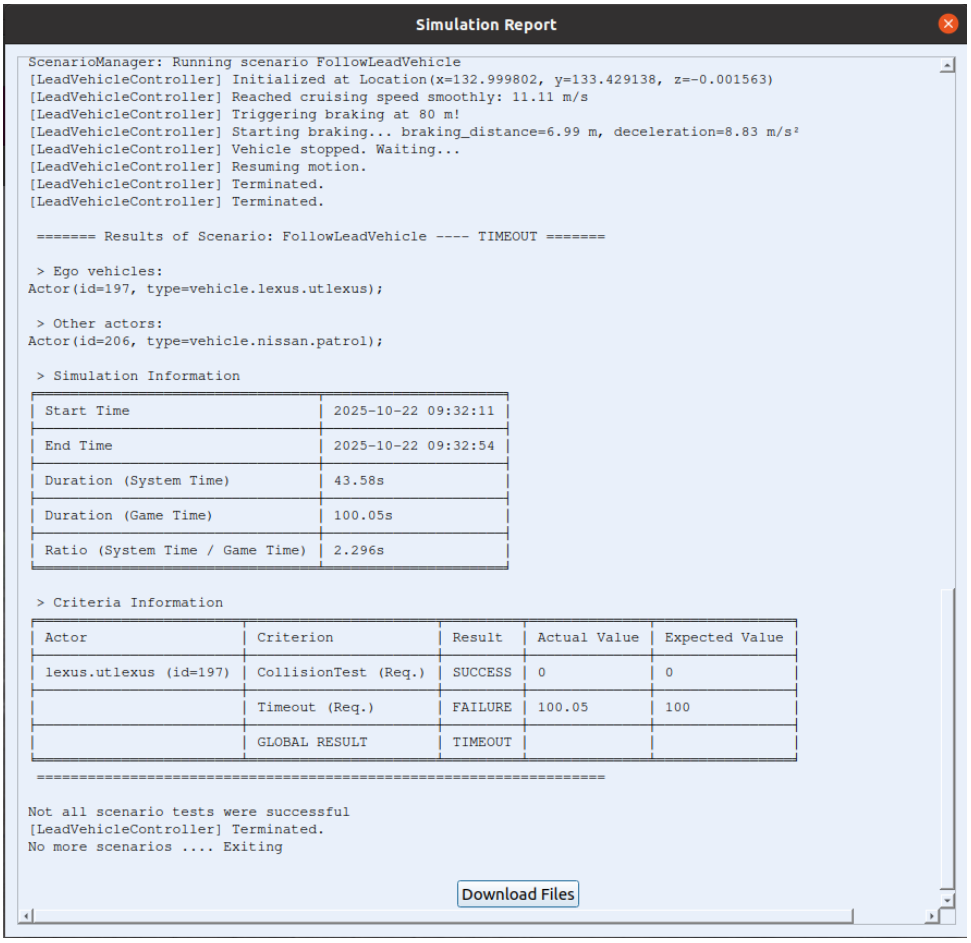
Step 10: Data Visualization Selecting *Show Results* displays the graphs for safety metrics and simulation Report shown below.



(a) RSS Minimum Safe Distance



(b) Jerk



(c) Simulation Report

Figure 11: Visualization of simulation results showing (a) RSS minimum safe distance, (b) jerk, and (c) simulation report.