ASAM OpenSCENARIO® XML 1.3.0

Release Presentation

Andreas Rauschert
BMW Group

Gil Amid
Foretellix Ltd

Mar 06, 2024
Toulouse

ASAM Association for Standardization of Automation and Measuring Systems

Agenda

1	Introduction
2	Motivation For New Release
3	New Features
4	Other Changes
5	Backward-Compatibility
6	Relations To Other Standards
7	Deliverables

Introduction

ASAM OpenSCENARIO XML comprises the specification and file schema for the description of dynamic content in driving simulation applications. The primary use case of ASAM OpenSCENARIO XML is the description of predictable highly precise scenarios that include complex maneuvers of multiple vehicles.

ASAM OpenSCENARIO XML may be used with external test specifications in virtual development, test, and validation of functions for driver assistance, automated driving and autonomous driving.

Scenario descriptions are essential for testing, validating, and certifying the safety of driver assistance systems and autonomous cars. The industry, certification bodies, and government authorities jointly define scenario libraries that can be used to test and validate the safe operation of such systems. A publicly developed and vendor-independent standard, such as ASAM OpenSCENARIO XML, supports this endeavor by enabling the exchange and usability of scenarios in various simulation applications.

As an example, with the help of ASAM OpenSCENARIO XML large numbers of critical situations can be run across various simulators. Thus, compared to road testing in real traffic, the number of test kilometers driven in field tests can be significantly reduced.

Motivation For New Release

Companies, which already use the ASAM OpenSCENARIO XML in their toolchains want to contribute by standardizing their customized extensions, so exchangeable scenarios can be modeled with the given feature set of ASAM OpenSCENARIO XML.

Also, ASAM OpenSCENARIO XML is currently being implemented by many suppliers and OEMs in their simulation toolchains. During implementation still several questions on interpretation of the standard arise and specification gaps are found. These shall be addressed in a new release to increase the predictability and exchangeability of the modeled scenarios and therefor also the quality of the standard.

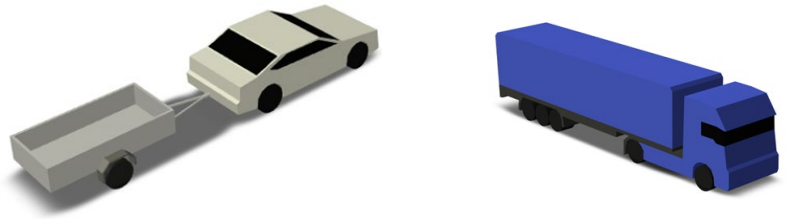
Finally, ASAM OpenSCENARIO XML as well-known international standard for simulation has attracted the attention of further companies in other application domains than automotive (for example trucks, drones, offroad vehicles).

There is a requirement to extend the applicability of ASAM OpenSCENARIO XML to these other domains.

New Features

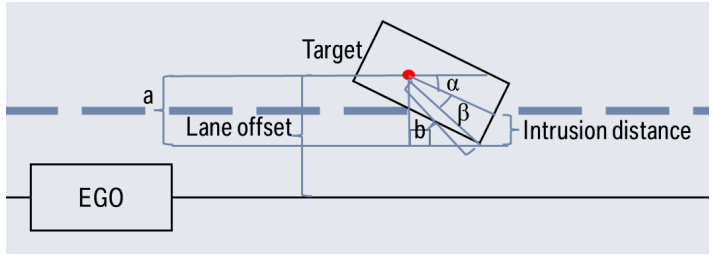
Trailer support

- Trailers can be modeled as vehicles with trailer hitch and coupler
- Trailers can be connected to and disconnected from towing vehicles



More functions in expressions

- Scenarios can contain more complex calculations
- Support for trigonometric functions, abs, sign, min, max added

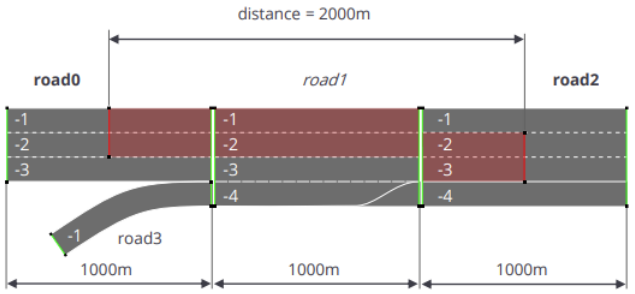


Traffic distribution

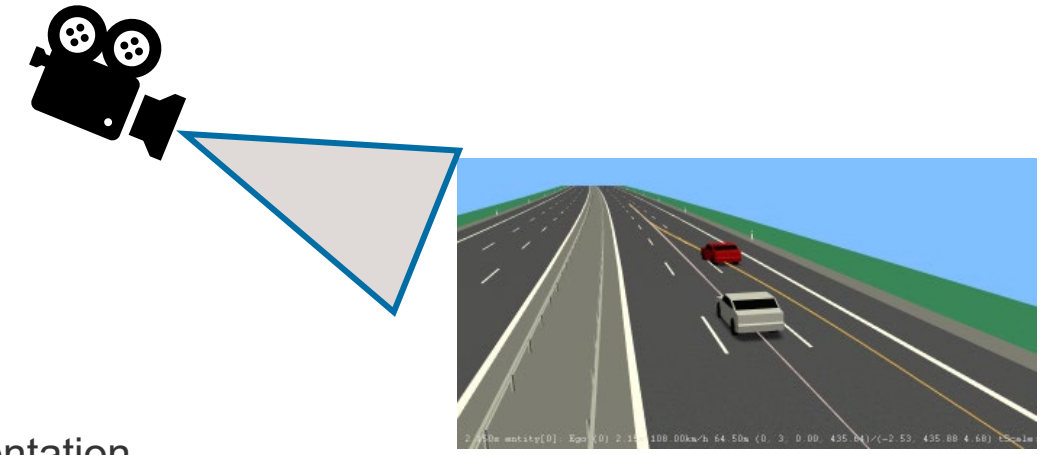
- Concrete entities to spawn can be defined (also pedestrians)
- Multiple groups of entities can be spawned
- Entities and controllers are coupled

Traffic area action

- Spawn area doesn't need a central entity
- Area can be defined as polygon or range of roads



New Features



Monitors

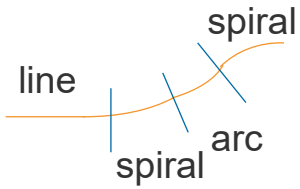
- Enables evaluation of scenario execution
- Increase robustness of scenario / test case against unintended execution

(Relative) angle condition

- Trigger actions when an entity reached a specified orientation
- Absolute orientation or relative orientation to another entity

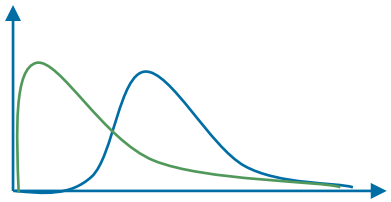
Clothoid spline

- Concatenation of clothoids in one trajectory
- Enabling for EURO NCAP test scenarios



Log normal distribution

- Improved stochastic variation of parameter values



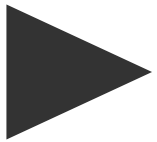
New Features

Optional scenario stop trigger

- Scenarios can run infinitely for endurance tests
- Test stop trigger can be defined outside of scenario

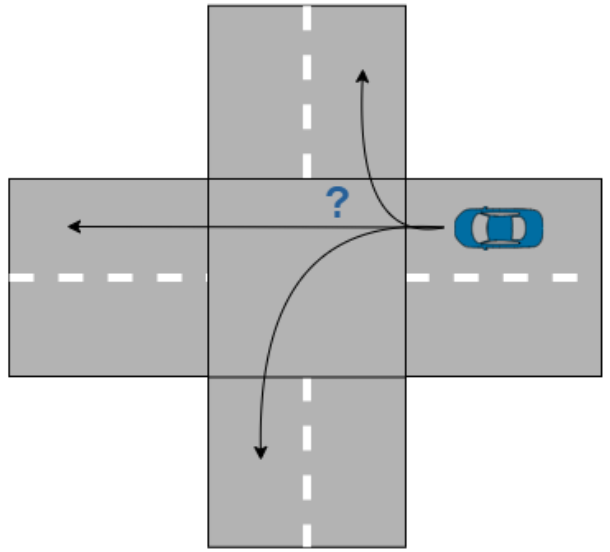
Optional Act start trigger

- For convenience, if Act should start right away upon scenario start
- Shorter scenarios



Random route action

- Possibility for explicit randomization of traffic behavior
- Default route behavior is deterministic and reproducible



Other Changes

Clarifications

- Use-cases of ASAM OpenSCENARIO
- End condition of `LaneChangeAction`
- `RelativeTargetLane` in `LaneChangeAction`
- Default route
- `Condition` behavior (rising edge)
- Vertical road selection for `GeoPosition`
- Speed calculation in `RelativeSpeedCondition`
- Number of executions of storyboard elements (`Act`, `ManeuverGroup`)
- Calculation of s-coordinate for `PositionInLaneCoordinates`
- Relative lane range in `RelativeClearanceCondition`
- End of road in `EndOfRoadCondition`

Harmonization

- Traffic signals (ASAM OpenDRIVE, ASAM OpenSCENARIO DSL)

Other Changes

Bugfixes

- XSD schema:
  - XOR implementations corrected
  - `Catalog` name identifier made mandatory
  - Custom `Properties` made optional
  - Name identifier added to `ObjectController` for referencing
- `Trigger` without `ConditionGroup` deprecated
- Relative orientation definition in `RoadPosition` & `LanePosition` corrected
- Lateral offset in `LanePosition` and `RelativeLanePosition` corrected
- Default `Orientation` changed to `relative`
- Example scenarios:
  - Documentation
  - Start / stop triggers
  - Controller handling
  - Negative rates
  - Global vs. local parameters
  - Parameter referencing
  - Realistic maneuvers
- Example roads (connections corrected)

Backward Compatibility

ASAM OpenSCENARIO XML 1.3.0 contains several corrections of errors in the XML schema file (.xsd) and is therefore not fully backwards compatible. All these corrections refer to errors where it was allowed to define semantically invalid scenarios (for example, specifying no element instead of exactly one element in an XOR). Therefore, a migration script (.xslt) is provided for converting scenario files from 1.2.0 to 1.3.0. If the migration script issues a warning, then the 1.2.0 scenario was already semantically invalid and would be syntactically invalid in 1.3.0. A scenario for which the migration script issues warnings must be checked and fixed manually.

ASAM OpenSCENARIO XML 1.3.0 also contains several corrections of calculation specifications for positions and orientations in the `Position` sub-classes, which makes this version not fully backward compatible. These changes do not affect the XML schema file but alter the interpretation and implementation of the standard in simulators. Because the previous calculation specifications would lead to incorrect or unexpected positions / orientations of entities in specific use cases, it is not necessary to implement different calculations for scenarios of version >= 1.3.0 and <= 1.2.0 respectively.

Because the non-backward compatible changes refer to bugfixes and no conceptual changes were done in the new release, the project group agreed on increasing only the minor version and not the major version.

For all versions, a strict XML schema file without the deprecated elements is provided, so that deprecated elements can be detected and removed or replaced manually.

Relations To Other Standards

Logical road network

ASAM OpenSCENARIO XML scenarios can refer to content of logical road network files. Therefore, compatibility between these formats and correct referencing must be ensured for valid scenarios. Examples are:

- ASAM OpenDRIVE
- Navigation Data Standard (NDS)

Simulation interfaces

If scenarios are used as input to environment simulators, there is an implicit relation to the output interfaces of the simulator. An example of such an environment simulator output interface is ASAM OSI.

3D models of road, scenery and objects

For more realistic scenario visualization and sensor modelling 3D model files can be referenced from the scenario. Currently there are no format limitations. Examples are:

- CityGML
- OpenSceneGraph
- glTF (Khronos Group)
- FBX (Autodesk)
- 3ds (Autodesk)

Deliverables

This standard comprises the following content:

Documents

- Specification
- UML Model reference

Additional items

- XML schema file
- Migration scripts and schemas
- Examples
- UML model