Public

openPASS – Content of pull-request for release 0.6

04.07.2019 – Reinhard Biegel

- **Support of scenario based simulation**
  - Static instantiation of agents based on systemConfiguration
  - Dynamic instantation of agents based on AppConfig (systemConfiguration template), ADAS and sensors are sampled based on probabilistic profiles
  - New agent modules for dynamically instantiated agents
  - Support of conditional interference during the simulation run via EventDetectors and Manipulators

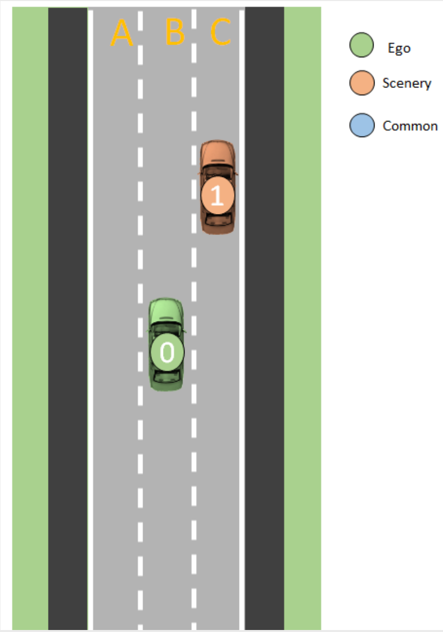
- **New SpawnPoint for scenario based spawning in the World_OSI with randomized spawning of traffic**

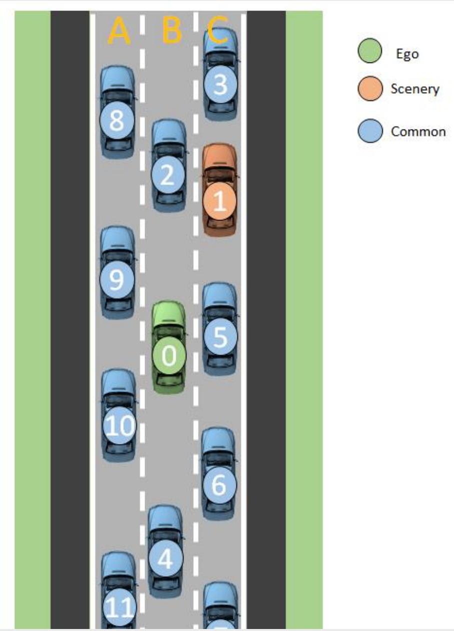
- **Update of World_OSI**

- **Improvement of OpenPassSlave**
  - New scheduler
  - Various new importers for scenario based simulation

Commit overview

- Places agents and static traffic objects in World_OSI
- Initial placement of ego and scenario agents according to Scenario.xml
- Additional agents are spawned to reach a defined TrafficVolume (Common cars)
- During runtime additional agents are spawned at start of road





SpawnPoint_OSI

- Implementation of ObservationInterface
- Responsible for adding RunStatistic information to simulation output
- Modules can access generic „Log“ method to add their own data to RunStatistics (interim solution until Publish-Subscriber is implemented)
- Logged values are divided into different groups. ExperimentConfig (in CombinationConfig.xml) defines which groups are written to the output
- Output is saved as XML-file

ObservationLog

- **EventDetectors check for conditions defined in Scenario.xosc**
- **If all specified conditions are met an event is inserted in the EventNetwork**
- **Based on the event a corresponding Manipulator is triggered**
- **Manipulators have different types and can act on different scopes**

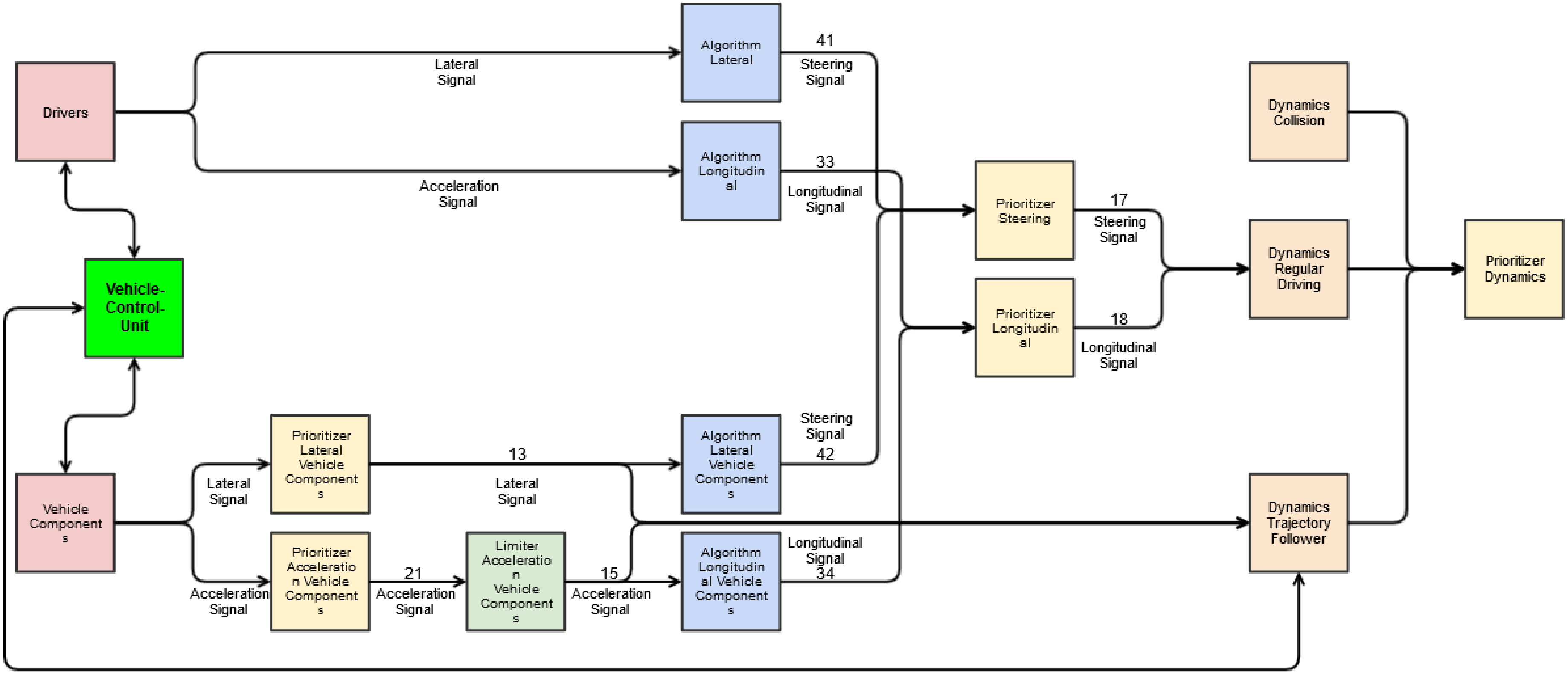
OSI use-case example:

- EventDetector activates, if SimulationTime > -1 (i.e. in first timestep)
- This triggers the ComponentStateChangeManipulator, which sets the ComponentState of the DynamicsTrajectoryFollower in the agent with name „TF“ to Acting.

```xml
<Sequence name="StateChangeSequence" numberOfExecutions="1">
    <Actors>
        <Entity name="TF"/>
    </Actors>
    <Maneuver name="StateChangeManeuver">
        <Event name="StateChangeEvent" priority="overwrite">
            <Action name="ComponentStateChange">
                <UserDefined>
                    <Command>SetComponentState DynamicsTrajectoryFollower Acting</Command>
                </UserDefined>
            </Action>
            <StartConditions>
                <ConditionGroup>
                    <Condition name="Conditional">
                        <ByValue>
                            <SimulationTime value="-1" rule="greater_than" />
                        </ByValue>
                    </Condition>
                </ConditionGroup>
            </StartConditions>
        </Event>
    </Maneuver>
</Sequence>
```

EventDetector and Manipulator

Overview of new agent modules



Drivers
Lateral Signal
Acceleration Signal
Algorithm Lateral
Algorithm Longitudinal
41
Steering Signal
33
Longitudinal Signal
Dynamics Collision
Prioritizer Steering
Prioritizer Longitudinal
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Longitudinal Signal
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Lateral Signal
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Acceleration Signal
Prioritizer Acceleration Vehicle Components
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Acceleration Signal
Limiter Acceleration Vehicle Components
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Acceleration Signal
Algorithm Longitudinal Vehicle Components
Longitudinal Signal
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Dynamics Trajectory Follower

Signalflow

Sensor_Driver

- Reads all *dynamic* mesoscopic information and information about own vehicle (e.g. velocity) via the AgentInterface and forwards aggregated data to the other driver modules as SensorDriverSignal

ParametersVehicle

- Reads all *static* information about the vehicle (i. e. VehicleModelParameters) via the AgentInterface and forwards aggregated data to the other driver modules as ParametersVehicleSignal

AgentFollowingDriver

- Implementation of a simple driver. Acts based on data from the signals above. Keeps a constant velocity, or adjusts velocity to the car in front

Algorithm_Longitudinal

- Translates the acceleration wish of the driver or a vehicle component into gear and pedal positions

Algorithm_Lateral

- Translates intended lateral deviation of the driver or a vehicle component into a steeringwheel angle

Driver modules

intech

- This module is an example for an ADAS in openPASS
- It implements a simple autonomous emergency braking (AEB) logic
- If the predicted time to collision (TTC) to another object is below a specified threshold, braking with constant deceleration is triggered

Algorithm_AEB

Sensor_OSI

- The Sensor_OSI module represents different types of sensors based on the OSI-groundtruth
- The output of Sensor_OSI is OSI SensorData
- Geometric2D-sensor is given as an example implementation of an OSI based sensor
- The Geometric2D-sensor acts as a 2D radar, detecting moving and stationary objects inside a circular sector
- Detection considering visual obstruction is supported

SensorFusion_OSI

- The SensorFusion consolidates SensorData of multiple OSI-sensors into a single SensorData structure
- The combined SensorData is forwarded to all ADAS

Sensor_OSI and SensorFusion_OSI

- The module is responsible for calculating the vehicle dynamics
- Pedal positions, steeringwheel angle and the current gear are translated into new values (velocity, acceleration and position) considering the vehicle‘s physical parameters
- Calculated data is forwarded as DynamicsSingal

Dynamics_RegularDriving

- In case a collision occured, Dynamics_Collision takes over the calculation from Dynamics_RegularDriving
- Collisions are modeled as simple inelastic collisions
- After the collision, Dynamics_Collsion decelerates the agent with a constant value of $10 m/s^2$
- Analogous to the Dynamics_RegularDriving module, calculated values are forwarded as DynamicsSignal

Dynamics_Collision

- This module can be used to force an agent to follow a predefined trajectory
- The agents position is set, velocity and acceleration is calculated based on the given trajectory provided by a CSV-file
- Trajectories can either be given in world coordinates or in absolute or relative road coordinates
- Dynamics_TrajectoryFollower can either be dominant (enforcing the trajectory) or submissive (trajectory can be overruled by an ADAS)

Dynamics_TrajectoryFollower

- Since a signal of a specific type can be created by different modules simultaniously, it‘s necessary to prioritize one of those signals before allowing consumption by a follow-up module
- Priority lists are used to decide which signal gets forwarded

- Examples:
  - The DynamicSignal can originate from the Dynamics_RegularDriving, the Dynamics_Collision or the Dynamics_TrajectoryFollower. The Dynamics_Collision has the highest priority and the Dynamics_RegularDriving has the lowest priority
  - Different ADAS can output an AccelerationSignal and a SignalPriotizer is used to decide which ADAS gets prioritized

SignalPrioritizer

The AgentUpdater calls setter-functions of the AgentInterface for all values of the DynamicsSignal

The Sensor_RecordState logs all basic agent based informations (e.g. agentID, velocity, position) via the ObservationLog

Sensor_RecordState

- The VehicleControlUnit (VCU) is used to configure and handle dependencies between vehicle components

- The responsibilities of the VCU are:
  - Handling of all dependencies in case a component wants to activate
  - Make information about driver, Dynamics_TrajectoryFollower and other vehicle components available to each other
  - Determine the highest allowed activation state of a component and notify the affected component about this state

- To achieve this tasks, each component is assigned a maximum allowed state in each timestep. This state is of type ComponentState, which defines Disabled, Armed or Active as allowed states.

- Drivers can be in a state of either Active or Passive.

Vehicle Control Unit (VCU)