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Formal Models for the Conceptualization and Characterization of Use Cases for the Autonomous Vehicle

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1. CONTEXT

Autonomous vehicles (AVs) perceive the environment with different kinds of sensors (Camera, Radar, Lidar…).

They must evolve in:

- unpredictable environment,
- dynamic context,
- with strong interaction.

Describe & generate different use cases. ➡ Validate the decisions of the algorithms. ➡ Ensure the safety (Avs, occupants, others road users).

2. OBJECTIVES

QUESTION: How can we generate the use cases to cover all the situations that the AVs may meet?

The main objective of this thesis is to develop a complete approach allowing:

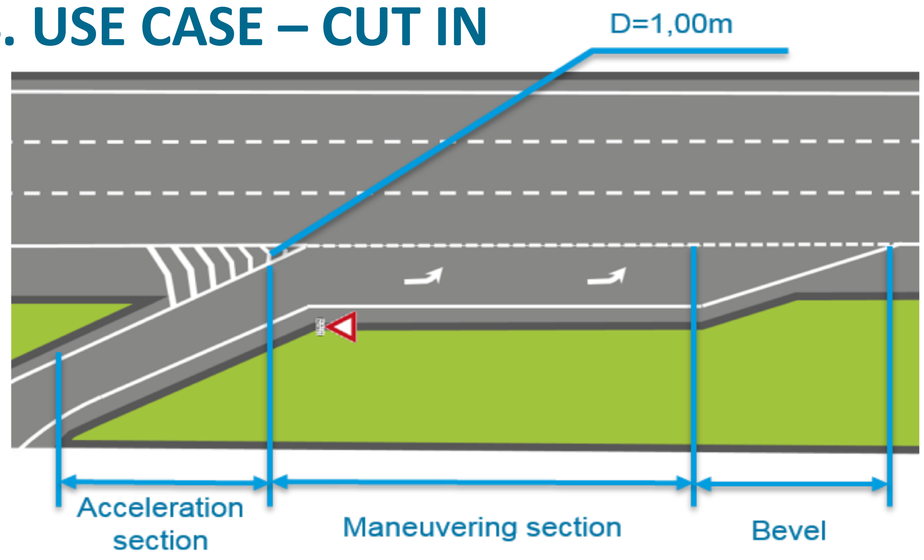
- Conceptualization and characterization of use cases ➡ Ontology construction methods.
- Formal modeling of use cases (scenarios).
- Automatic generation of use cases.

3. ONTOLOGY

Methodology of the ontology construction:

1. Identification:
   - Identification of the concepts and relationships in the domain of interest.
   - Production of precise unambiguous text definitions for such concepts and relationships.
   - identification of terms to refer to such concepts and relationships.
2. Representation:
   - Commit to the basic terms that will be used to specify the ontology.
   - Choose a representation language.
3. Integrating Existing Ontologies.

4. USE CASE – CUT IN

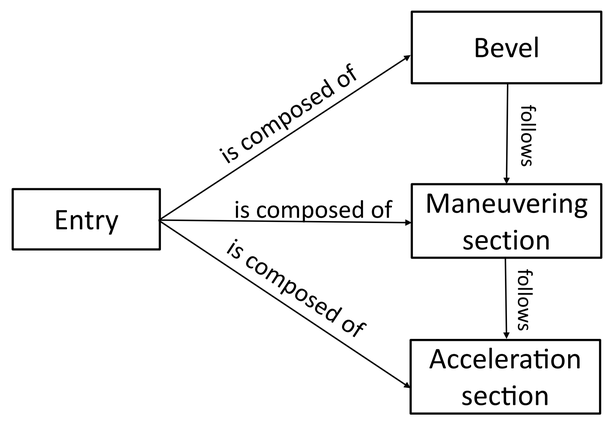


Concept: Entry

Definition: a lane which allows vehicles accessing a highway to accelerate until integrating the highway flow.

Attributes:

- Geometry.
- Topography.
- Length.
- Width.
- Maximum speed.



Relationships:

- Composition relationship:

  IS_COMPOSED (C,E) : C is composed of the elements in the set E where

  C = Entry
  E = {Acceleration section, Maneuvering section, Bevel}

- Location relationship :

  FOLLOWS (C_1, C_2) : C_1 follows C_2 where

  C_1 = Bevel, C_2 = Maneuvering section
  C_1 = Maneuvering section, C_2 = Acceleration section

5. FUTURE WORK

FORMAL METHODS: techniques with a mathematical foundation for the specification, development and verification of software and hardware systems.

REFERENCES

[1]. Allemang, D., Hendler, J.A. : Semantic Web for the Working Ontologist - Eective Modeling in RDFS and OWL. Morgan Kaufmann, second edn. (2011)

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