A Graph-based Framework for Coverage Analysis in Autonomous Driving

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1 Abstract

2 Introduction

- In autonomous driving, coverage analysis is a crucial step to ensure the safety and reliability of the system.
- In most situations, coverage arguments are collected either per coverage factor, or maybe up to 2 or 3 factor interactions.
- See for example [10] for an production grade implementation of state of the art coverage analysis.
- In contrast to existing approaches, this paper proposes a graph-based framework for coverage analysis.
- There are already other graph-based approaches for analysing and representing traffic scenes, see for example [5].
- However, the work in that paper is not specifically focused on coverage analysis.
- Hence in this paper, graph based traffic scene representations are utilized for coverage analysis.
- This paper is structured as follows:
  - In the first section, xxx

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3 exsting coverage and analysis approaches

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4 Defining a traffic scene graph

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4.1 time based graph representations

5 Analysing a traffic scene with agraph

- Having defined a graph-based traffic scene representation, we can now analyse the coverage of the system.
- Two methodologies are proposed for this purpose:
- One is to define archetypes of traffice scenes, and to compare graphs from observed traffic scenes to these archetypes.
- The second one is to translate graphs to graph embeddings, and then to compare the embeddings of different sets of traffic scenes.

5.1 Create subgraphs for coverage analysis

- There is a lot of knowledge in the literature on how to define archetypes of traffic scenes.
- Once an archetype is defined, a special property of graphs can be used.

- Two graphs are isomorphic if they have the same structure, regardless of the node and edge labels.
- As the archetypes are not necessarily are involving a lot of actors, these are more like subsets of actual traffic scenes.
- A very simple example might be 2 vehicles on the same lane, driving in the same direction and another vehicle driving on a neighboring lane.
- This situation can be represented by a graph with 3 nodes and 2 edges.
- In most real traffic situations however, there will be additional actors present, so that we are not searching for isomorphic graphs, but rather want to check if any subgraph of G is isomorphic to the archetype graph A.
- This is an example of a subgraph isomorphism problem.
- While this problem is NP-hard, the graphs considered here are rather small, so the computational time is reasonable.
- One such algorithm is the VF2 algorithm, which is implemented in the NetworkX library. ¡- Check and cite something.
- The strategy we are then applying is

5.2 graph embeddings for coverage analysis

6 Application

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7 Summary

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