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Online Automotive Hazardous Scenario Identification

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1 Introduction

Automated Driving (AD) vehicles are often seen as a way to make public roads safer. To have confidence in AD vehicle safety, these systems are currently deployed in geofenced areas under limited conditions. However, deployed AD vehicles will eventually encounter unforeseen or changing environments, exposing new edge cases in AD systems [5]. This necessitates both flexible immediate risk mitigation and feedback on the overall safety performance of the system. Multi-channel architectures using redundant and heterogeneous AD systems as parallel AD channels are proposed as suitable methods to reduce immediate risks of newly exposed edge cases [3, 4]. Unfortunately, current hazard-mitigation methods using cross-channel comparisons do not identify what issues contribute to the emergent hazard. Other overall safety and especially perception safety tracking functions are either computationally heavy and AD version specific or limited in their scope [5]. Therefore, we propose a new way to re-use the capabilities of multi-channel architectures to identify hazardous scenarios for enhanced continuous monitoring.

2 Daruma framework

As proposed by the UL4600 standard and the AVSC best practice guidelines, we use safety performance indicators (SPIs) to track the performance of safety claims. As seen in Fig. 1, we use the redundant AD channels (V.1) both to mitigate risks (V.2) and to compute SPIs (V.3). Via function (V.4) we extract hazardous scenarios and possible contributing causes from these SPIs. We use three SPIs, based on – (a) object count similarity, (b) ego location similarity and (c) safety scores. The system is tested using the setup developed in [3], using the CARLA simulator and the longest-6 benchmark [2], with AD channels Learn from All Vehicles (LAV) [1] and Transfuser [2].

3 Results

Using function (V.4), we successfully identify 87% of hazardous scenarios, as evaluated by the simulation operator. More importantly, the system automatically identifies contributing causes to hazardous scenarios, as shown in Table 1. For example, the framework automatically identifies significant WM issues in the Transfuser channel, as it does not detect pedestrians. Next, 48% of identified hazards judged to be unrealistic by the operator. These are detected due to an overly conservative WM in the LAV channel. Without cross-comparing redundant AD channels and exposing that information concisely, such glaring issues can go undetected.

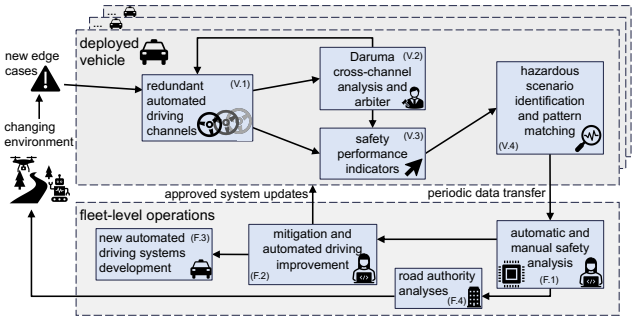

Figure 1: The Daruma framework, with both online risk mitigation, safety performance indicator tracking and hazardous scenario identification.

Table 1: Overview of the identified contributing issues detected via the hazardous scenario identification logic.

Route	1	2	3	4	5	6	Total
Identified issues	32	26	28	15	10	14	125
WM issues	13	12	10	5	5	4	49
MP issues	15	12	17	9	6	9	67
Location issues	2	1	1	1	0	1	6
Unknown issues	2	1	0	0	0	0	3

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