



Investigation of the time spent in dangerous driving conditions: Findings from the i-DREAMS project

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INTRODUCTION

The development of the 'Safety Tolerance Zone' (STZ) is the main aim of the European H2020 project i-DREAMS. This zone, although abstract in nature, refers to the self-regulated control of transportation vehicles by human operators in the context of crash avoidance, and exploits task complexity indicators along with driver background factors for a continuous real-time assessment of safe driving operation. The STZ consists of three phases: Normal Driving phase, Danger phase and Avoidable Accident phase.

OBJECTIVES

The aim of this work is to identify **how much time is spent in the three levels of the STZ for driving speed**. To that aim, the most reliable indicators of task complexity, such as time headway and distance travelled or weather conditions are going to be assessed.

DATA COLLECTION

A **naturalistic driving experiment** and data from 20 Belgian car drivers was utilized during a 3-month timeframe (from 21/07/2021 to 30/10/2021). Trip data were collected from a specific subset of the population of Belgium and additional information, demographic or personal characteristics of the examined sample (e.g. gender, age, educational level) were not included in this analysis.

Data from the **Mobileye system, a CardioDashcam and the CardioGateway** which record driving behavior along with GNSS signals were used. The explanatory variables of risk and the most reliable indicators of task complexity and coping capacity were assessed, as presented in Table 1.

Table 1: Descriptive statistics of the analysis variables

Variables	Mean	SD	Min	Max	Sample Size
Headway measurement (s)	69386	35611	0.31	99999	1820
Forward collision warning	0.00	0.00	0.00	0.05	1820
Average speed (km/h)	90.86	30.00	1.94	137.07	1820
Distance travelled (km)	618.57	163.94	10.8	1021.80	1820
Harsh acceleration events	0.07	0.22	0.00	1.00	1820
Harsh braking events	0.01	0.09	0.00	1.00	1820
Lighting conditions (day/night)	1.45	0.82	1.00	3.00	1820
Weather conditions (wipers)	0.03	0.16	0.00	1.00	1820
Headlight beam	0.00	0.03	0.00	1.00	1820
Time spent in each STZ level	352.70	1476.50	30	37830	1820
STZ for driving speed	0.22	0.46	0.00	2.00	1820

METHODOLOGY

Two classification models, **Conditional Inference Tree** and **Support Vector Machine** were developed to identify the three phases of STZ. The structure methodology along with the proposed characteristics to estimate the time spent in each of the STZ levels is shown in Figure 1.

Figure 1: Proposed methodology for the definition of the STZ for speed

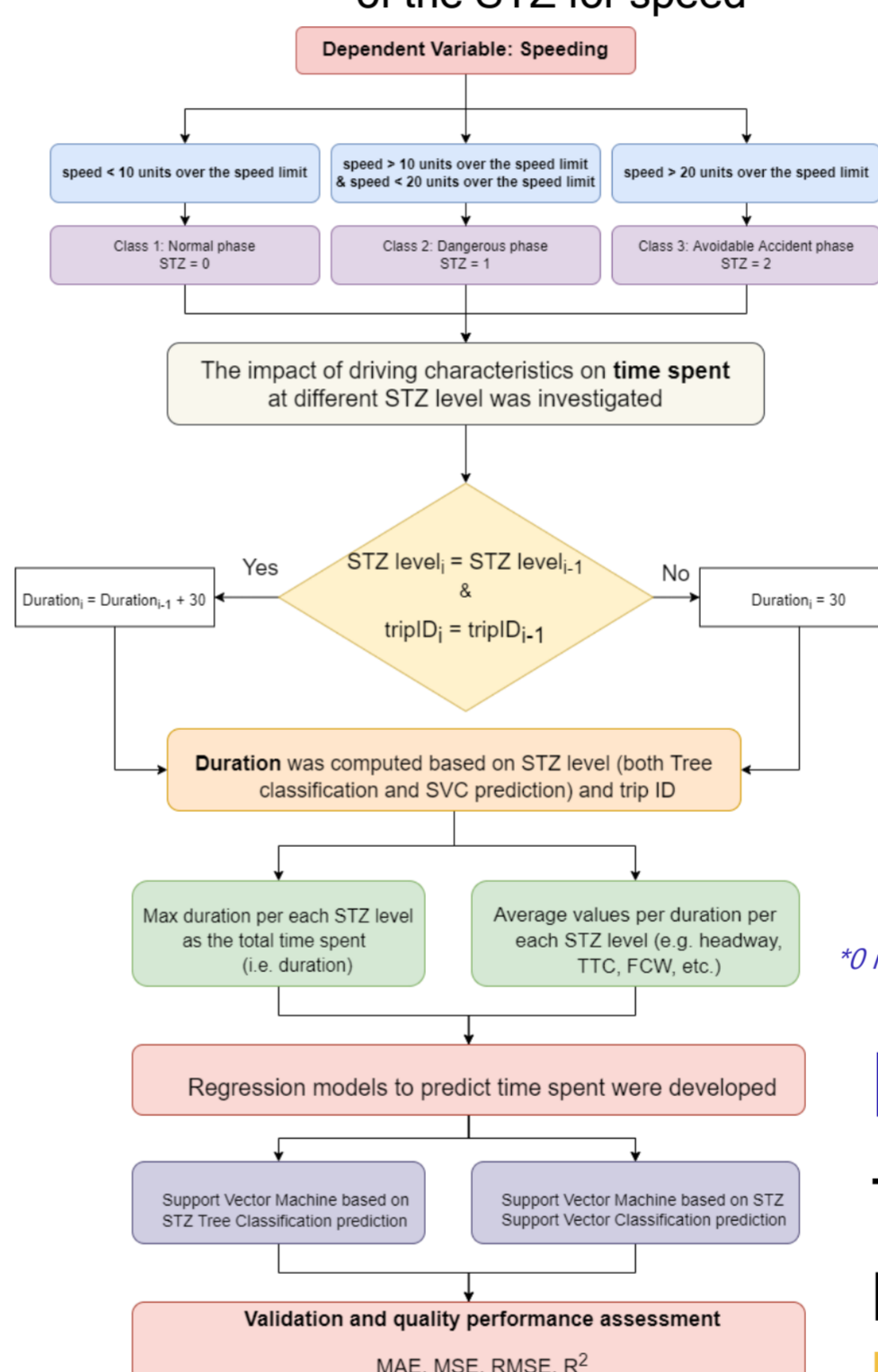


Table 2: Results of STZ from Tree Classification

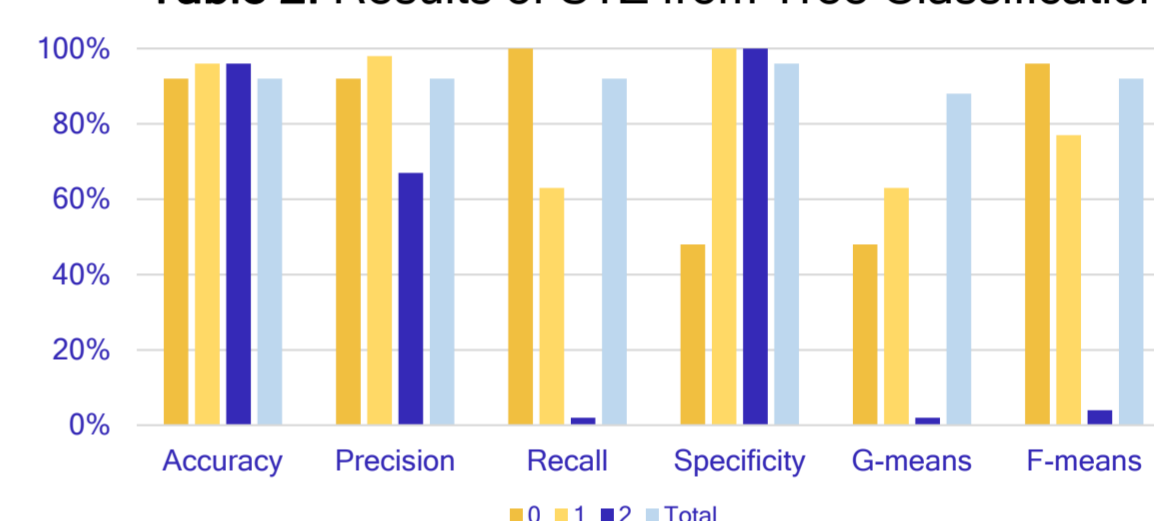
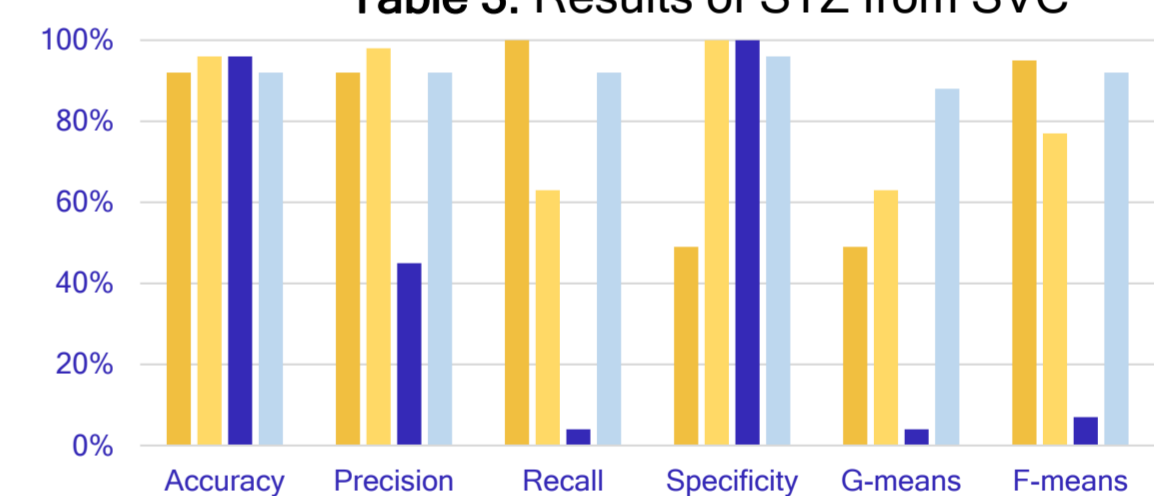


Table 3: Results of STZ from SVC



*0 refers to normal phase, 1 refers to dangerous phase, 2 refers to avoidable accident phase

RESULTS

The classification methods provided predictions with **92% accuracy and recall and 96% specificity**, in total.

Looking into regression results, SVM models presented RMSE=526.0 and R²= 81.48%, using STZ from Conditional Inference Tree Classification and RMSE=524.35 and R²= 81.60%, using STZ from Support Vector Classification.

CONCLUSIONS

The conclusions drawn from the current research can serve as the **base for building the mathematical models** which are the backbone of the development of the i-DREAMS platform. Constructs to be measured are the driver's cognitive and behavioral state in terms of time spent in dangerous driving conditions as well as more stable characteristics which are known to impact safe driving and therefore, road safety.

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