Autonomous driver identification using vehicle trajectory data

Conference Poster

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Autonomous driver identification using vehicle trajectory data

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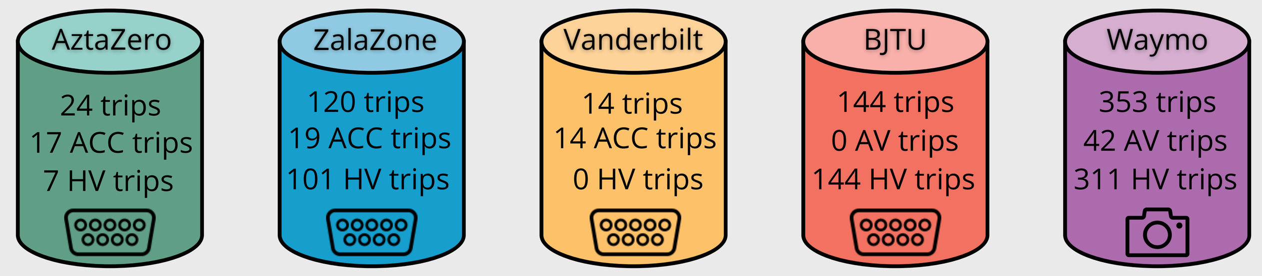
Idea

Robust identification of automated driving only by observing inexpensive raw trajectory data, i.e. speed, acceleration and spacing.

Background

Prominent behavioral differences exist between human drivers (HV) and automated driving (AV). These differences gradually introduce unprecedented patterns in already complex road traffic dynamics. Knowledge of whether a human or a controller operates a vehicle could quantify the impact of AVs and leverage new possibilities for sustainable mobility.

Data

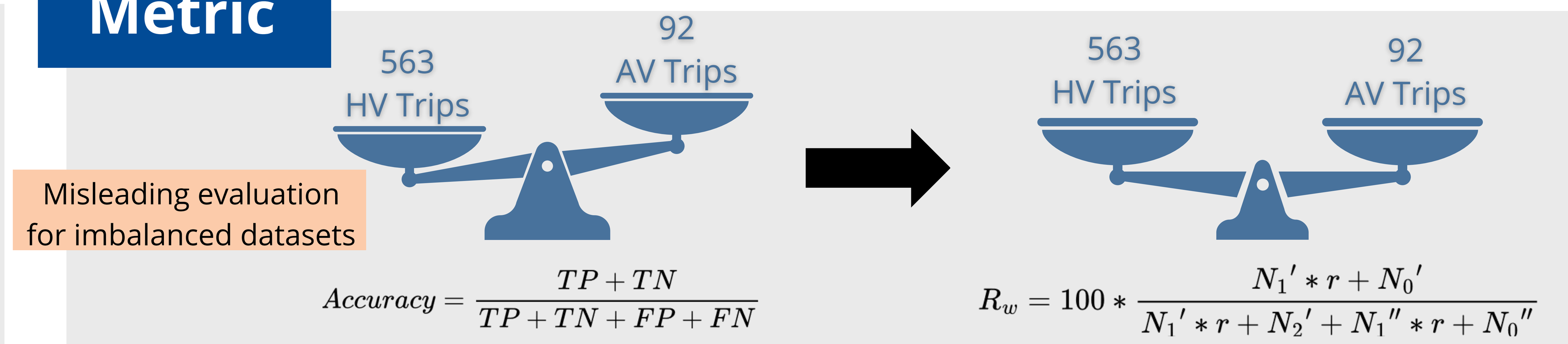


Total trips: 655 Total AV trips: 92 Total HV trips: 563

Scenarios

1. Training, validation and test data is composed by: **AztaZero, Zalazone, Vanderbilt, BJTU** (4) → Concept Drift (**CD**): **Waymo**
2. Training, validation and test data is composed by: **AztaZero, Vanderbilt, Waymo, BJTU** (3, 1) → Concept Drift (**CD**): **Zalazone**

Metric



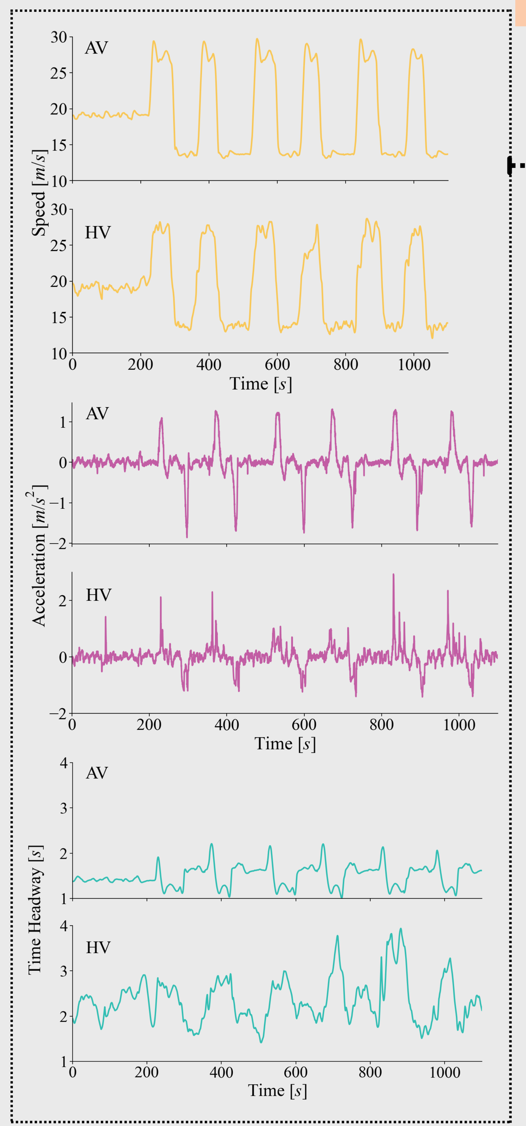
$$Accuracy = \frac{TP+TN}{TP+TN+FP+FN}$$

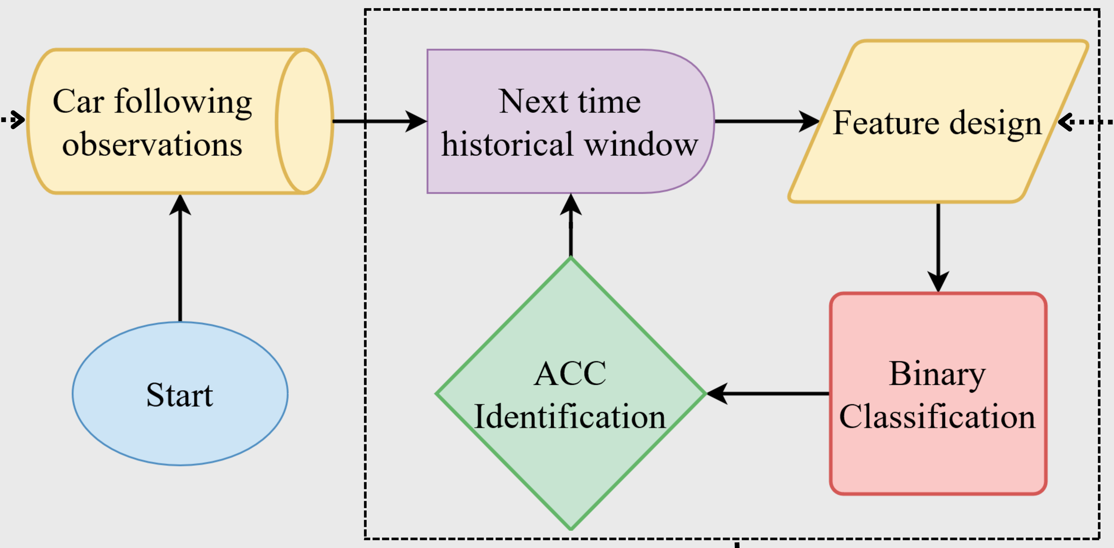
$$R_w = 100 * \frac{N_1' * r + N_0'}{N_1' * r + N_2' + N_1'' * r + N_0''}$$

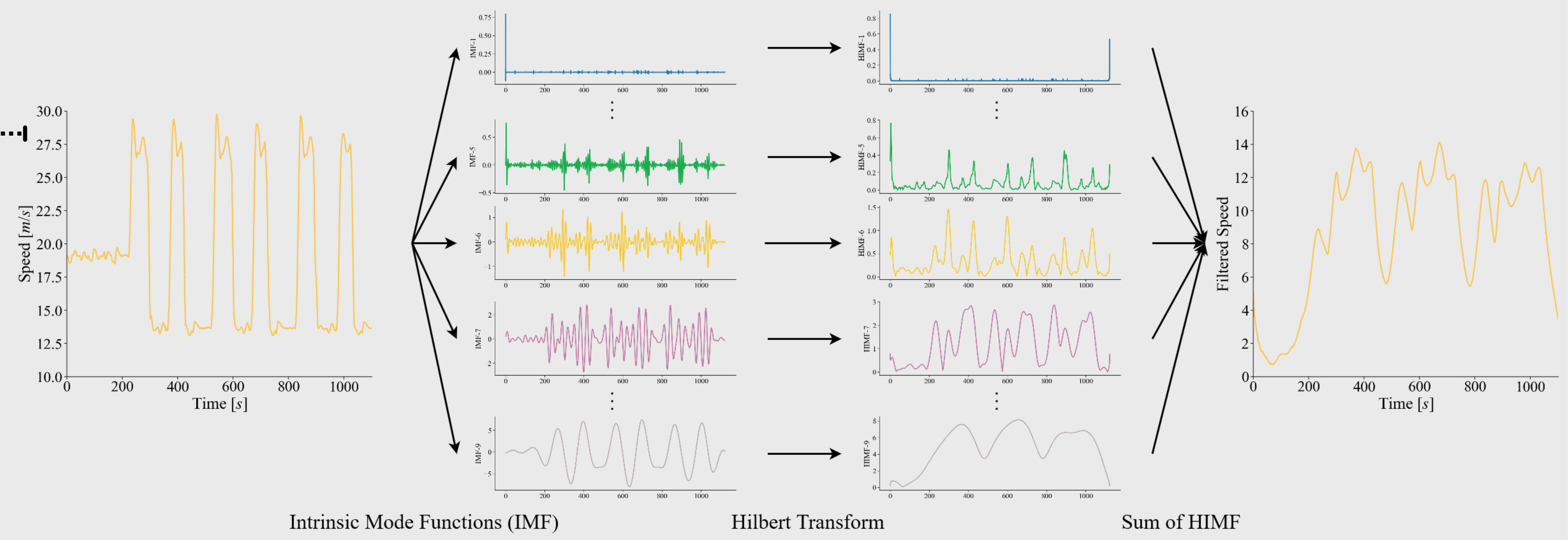
Methodology

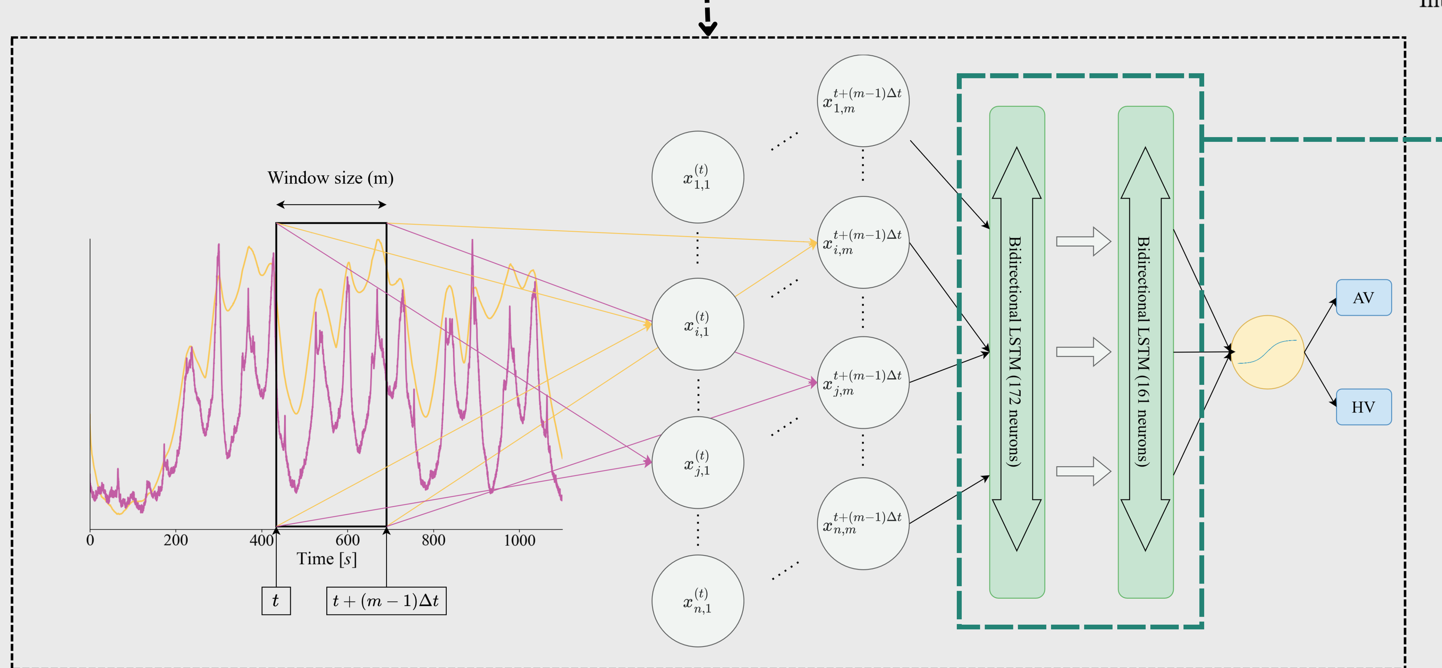
For each input signal, we calculate the **standard deviations** over a past-time step window

We create a **time-frequency features** on the time series based on **Hilbert transform**







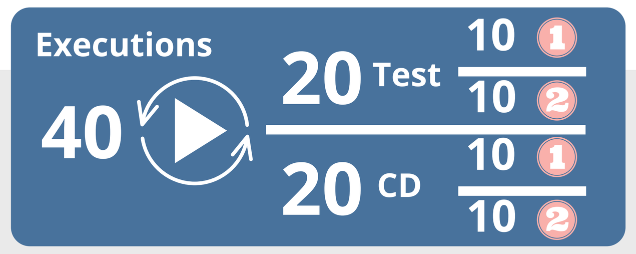


Features (#)	Epochs (#)	Batch size (#)	Learning rate	Window size (10[Hz])
6	200	100	0.001	50

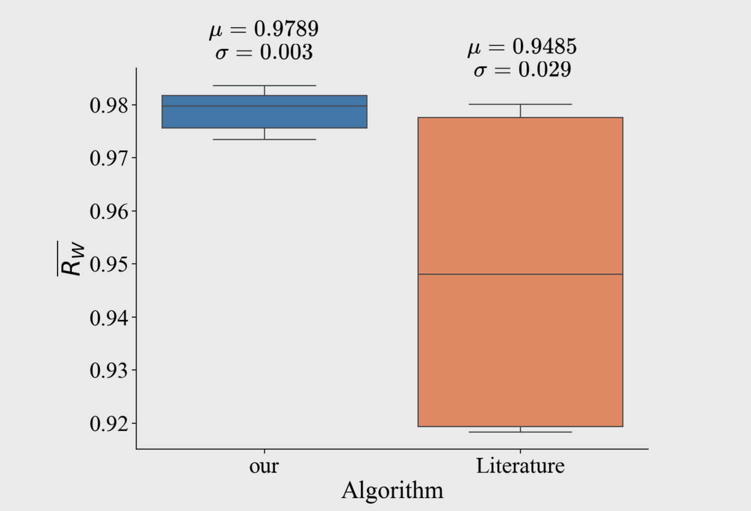
Layer	Activation function	Recurrent activation function	Neurons (#)	Drop out (%)
Input layer	tanh	sigmoid	172	40
Hidden layer	tanh	sigmoid	161	40
Output layer	sigmoid	–	1	0

Results and Discussions

CD refers to the phenomenon in machine learning where the statistical properties of the data being processed change over time, potentially leading to decreased model performance.



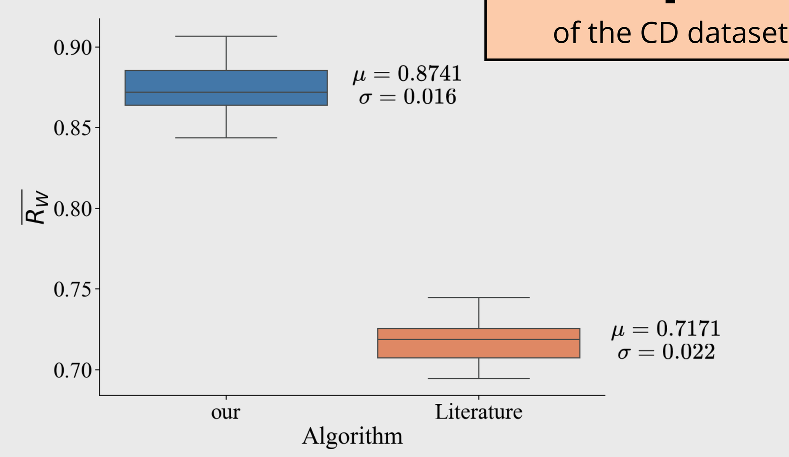
Test



Concept Drift

10% Train	90% Validation

of the CD dataset



Major Findings:

- Our method is available to identify ACC and AV.
- Our method performs in a imbalance dataset without in favor of the majority class.

Method Advantages:

- Our method is available to generalise to new datasets from different sources.

Conclusion

We propose a method for identifying autonomous driving in unseen datasets that has high accuracy and reliability. It can classify ACC and AV based on speed, acceleration and Timeheadway. The LSTM considers context from previous and future frames, improving performance. This method has high accuracy and reliability for identifying autonomous driving in unseen datasets, making it a promising approach for real-world applications.

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