

# Unsupervised Anomaly Detection for Safe Robot Operations

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## Motivation

To deploy autonomous robots:

- Without the need of human supervision.
- In a human-shared environment without the safety concerns.

## Challenge

To detect the anomalous behaviour in a robot at the earliest to ensure safe robot operations.

## Solution

OCSVM based anomaly detection system which is:

- Data-driven - no need to model faults.
- Unsupervised - no need of labelled data.
- One-class classification - requires only data for the normal operation.

## Methodology

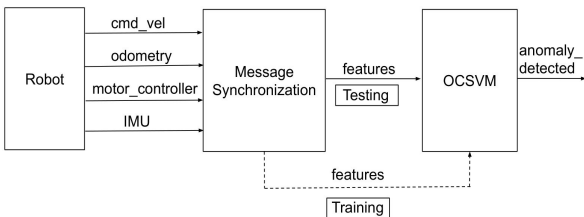


Fig 1, Overview of the proposed framework.

## Example

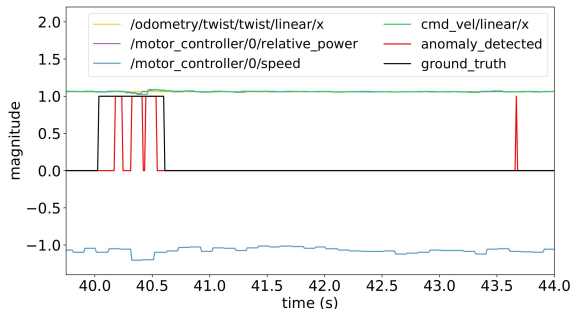


Fig 2, The anomalous behaviour detected correctly (left) and the false detection (right) are shown.

## Results

We evaluate our approach in multiple real-world scenarios with data collected from a real robot.

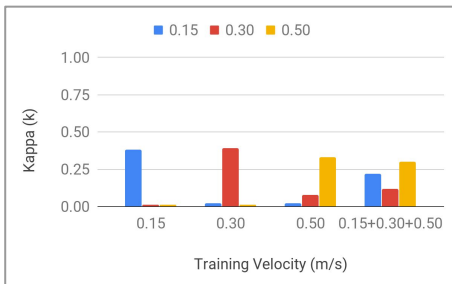


Fig 3, Performance evaluation with Kappa

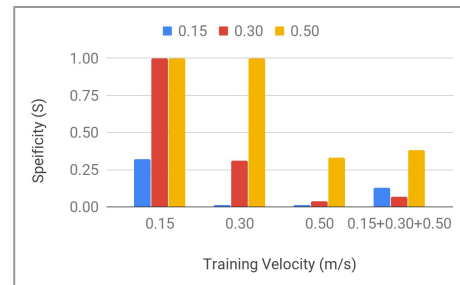


Fig 4, Performance evaluation with specificity

As the datasets are highly imbalanced, Cohen's Kappa coefficient ( $\kappa$ ) and specificity (S) were used to evaluate the performance of the classifier.

## Conclusion

We proposed OCSVM based anomaly detection method which uses multimodal data fusion to detect the anomalous operation of a robot in human accompanied environments. We evaluated our approach in multiple real-world scenarios.

## Future Work

To improve the performance, we are interested in learning more about the:

- Temporal aspect of the data.
- Feature selection approaches for one-class classification.