

Traffic Anomaly Detection

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Traffic Anomaly Detection

- Subfield of behavior understanding from video surveillance
- aberrations of scene entities (vehicles, human or the environment) from the normal behavior
- Combined with the vehicle fire, fatality people, and damage to environment

A Typical Anomaly Detection Framework

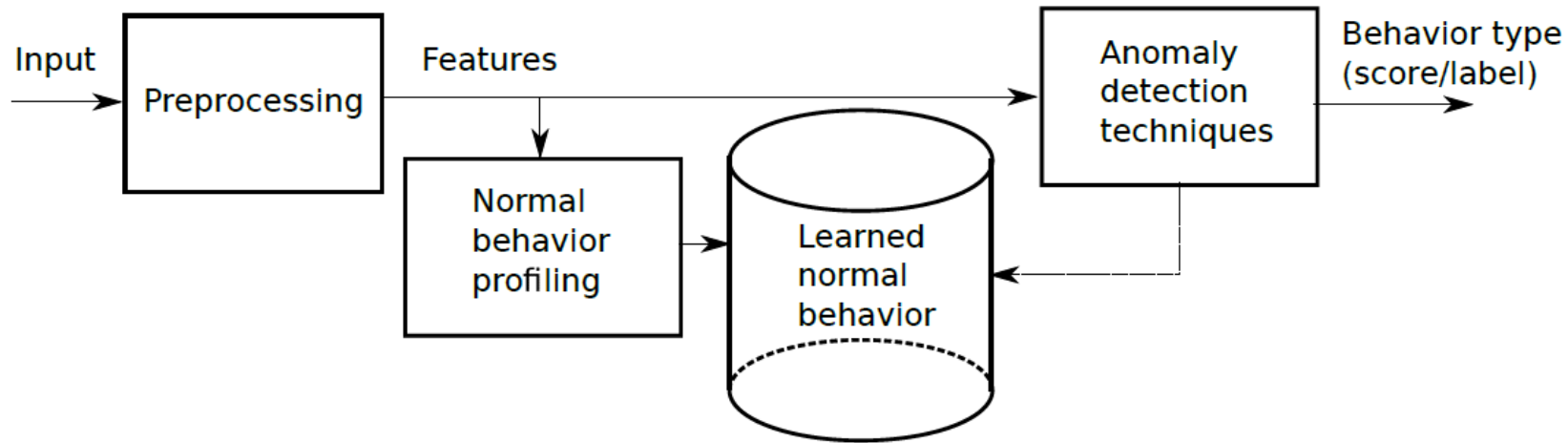


Fig. 1. Overview of a typical anomaly detection scheme. Preprocessing block extracts features/data in the form of descriptors. The normal behavior is represented in abstract form in terms of rules, models, or data repository. Specific anomaly detection techniques are used for detecting anomalies using anomaly scoring or labeling mechanism. [1]

Application Domains

- Improving driving safety in autonomous systems
- Helping the driver attention prediction
- Intelligent monitoring in diverse and different driving scenarios
- Speeding up construction on intelligent transportation
- Avoiding road fatalities

Key Challenges

- Low Anomaly Detection Accuracy
 - Huge diversity of situations on real-world roadways
- Contextual Data
 - The notion of anomaly is not same in all application contexts
- Imbalanced Data
 - The dynamic traffic scene, intricate and imbalanced accident categories

Anomaly Detection Approaches

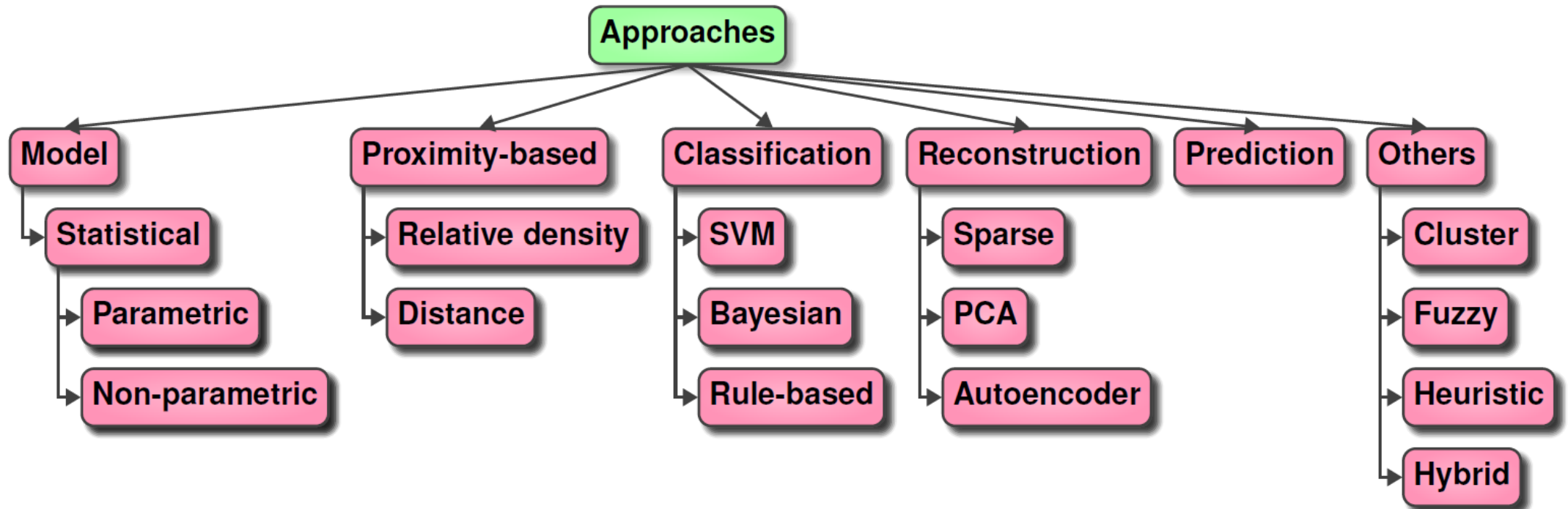
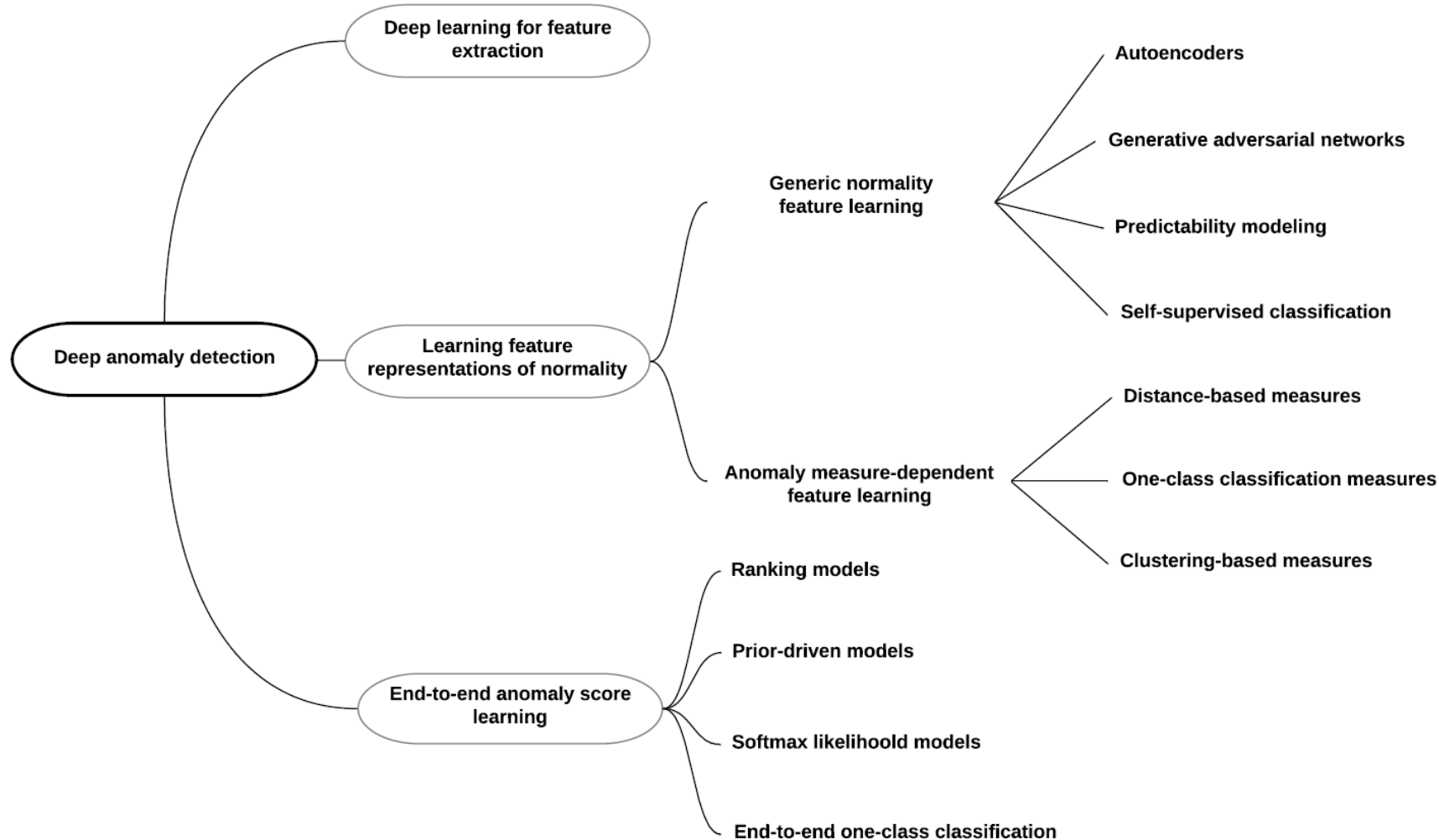


Fig. 3. Classification of the anomaly detection methods based on different approaches. [1]

Taxonomy of Deep Anomaly Detection Techniques



Important Traffic Anomaly Categories

TABLE 2: Traffic anomaly categories in the DoTA dataset. [3]

Label	Anomaly Category
ST	Collision with another vehicle that starts, stops, or is stationary
AH	Collision with another vehicle moving ahead or waiting
LA	Collision with another vehicle moving laterally in the same direction
OC	Collision with another oncoming vehicle
TC	Collision with another vehicle that turns into or crosses a road
VP	Collision between vehicle and pedestrian
VO	Collision with an obstacle in the roadway
OO	Out-of-control and leaving the roadway to the left or right
UK	Unknown

Public Datasets in Traffic Anomaly Detection

Dataset	type	# anomaly videos	Annotations
StreetAccident [4]	Dashcam	620	temporal
A3D [6]		1500	temporal
CCD [5]		1500	temporal, spatial, causation
DADA [7]		2000	temporal, spatial
DoTA [3]		4677	temporal, spatial, categories

Famous Metric

- AUC
 - Area Under the Receiver Operating Characteristics Curve (AUC)

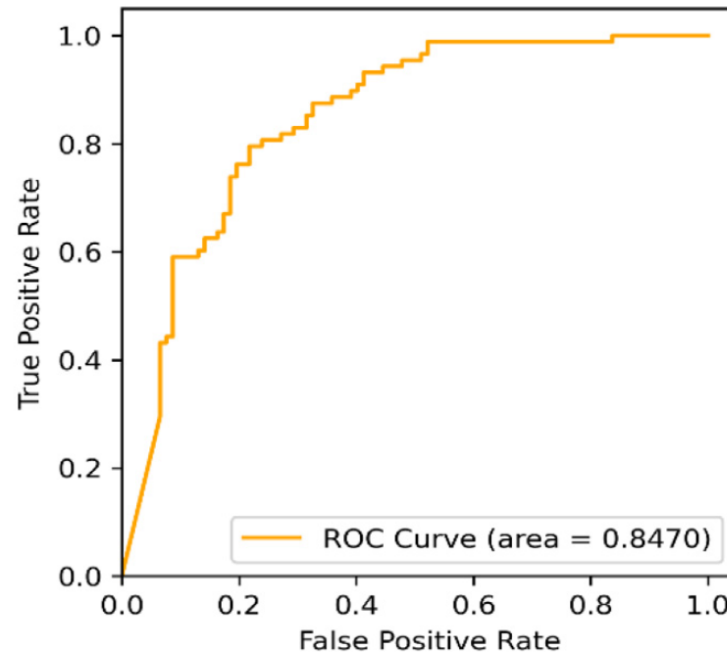


Fig. 13. ROC at frame-level evaluation (AUC = 84.70%). [8]

[8]. Pawar, K. and Attar, V., 2021. Deep learning based detection and localization of road accidents from traffic surveillance videos. ICT Express.

Performance Comparison(%) on Bigger and more Important Datasets

Dataset	AUC	Method-Year
DoTA	84.70	Proposed Model [8]- 2021
DADA	67.5	DeepMask-FP-TAD [9]- 2021
A3D	67.8	SSC-TAD[10]- 2022

Future Directions

- Generalizing from limited labeled driving anomalies to novel anomalies in the traffic applications
- Promoting Reinforcement Learning approaches to explore novel anomalies
- Interpreting the deep models in anomaly detection approaches
- Learning best parameters and architectures in deep anomaly detection methods
- Capturing temporal/spatial dependence in a united framework

Thank You

References

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