Anomaly Candidate Identification and Starting Time Estimation of Vehicles from Traffic Videos

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    1) Gaussian mixture models(GMMs): 전경 마스크 + 배경 이미지 생성 => 이상 객체 식별
    2) TrackletNet Tracker(TNT): 이상 객체에 대한 trajectory를 계산하여 시간을 추정
  - Track 3 testing set of CVPR AI City Challenge 2019 City Flow dataset => S3 score performance of 93.62%

2. Proposed Method

- Traffic videos에서 Vehicles 이상 탐지와 이상 시작 추정을 위한 2단계 프레임 워크

  1) Anomaly Candidate Identification

     ① Gaussian mixture models(GMMs)를 이용하여 전경 / 배경 추출

     ② 각 비디오의 전경 이미지를 합산 차량 흐름 감지를 위한 ROI(region of interest) 교통 흐름 마스크 생성

     ③ 배경+ROI 모두 있는 Vehicles 객체는 도로에 멈춰 있는 객체로 판단하여 Anomaly Candidate Identification

  2) Anomaly Starting Time Estimation

     ① TrackletNet Tracker(TNT)를 이용, 이상 Vehicles 객체의 trajectory 검출 가능

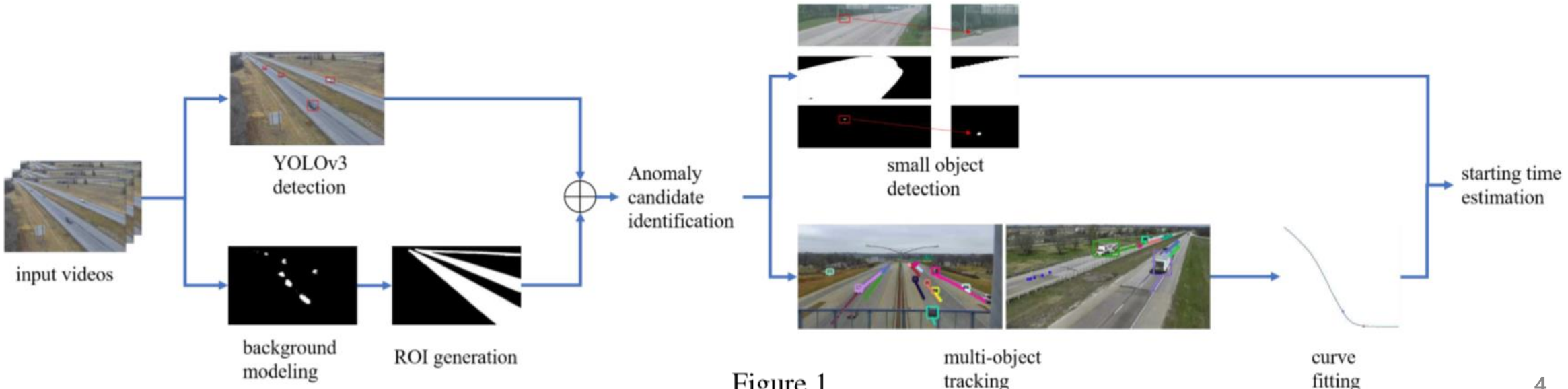

Figure 1.

2. Proposed Method

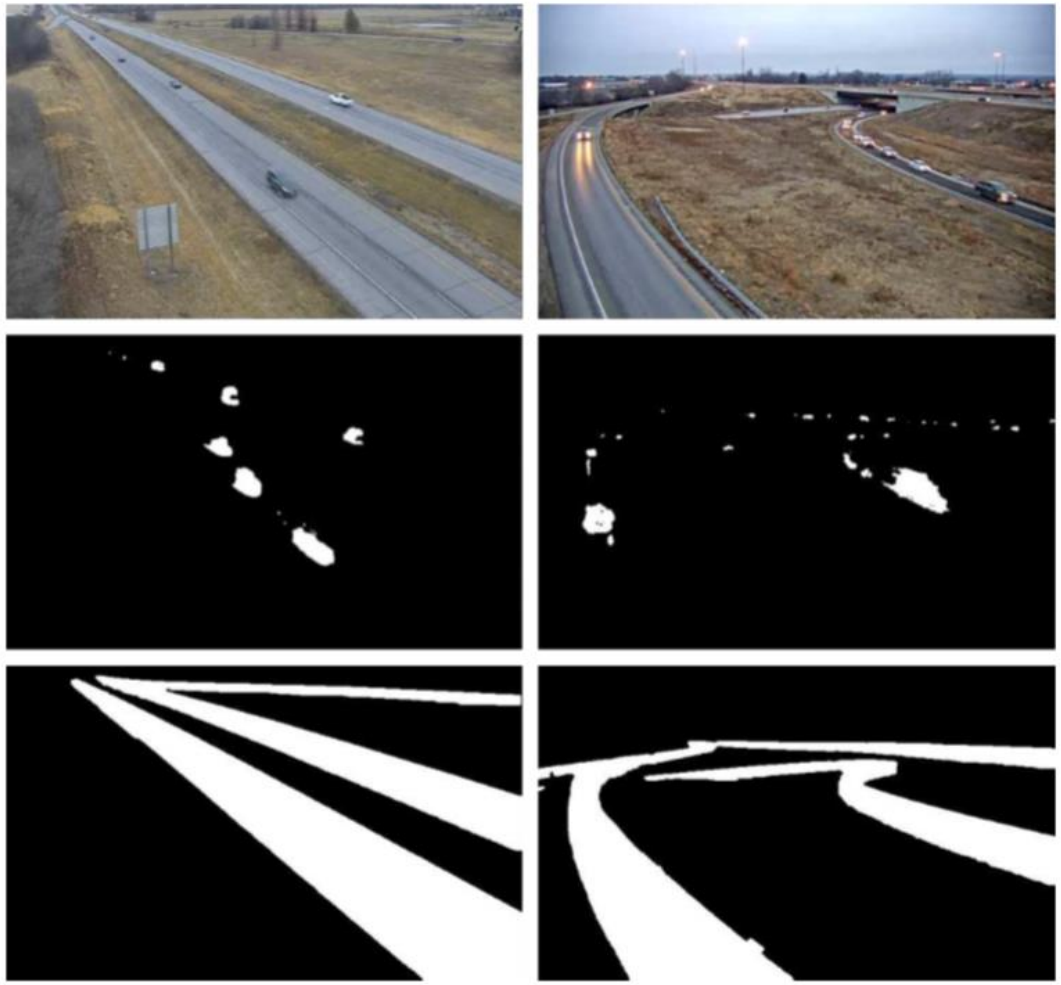

Figure 2. Examples of background modeling and traffic flow mask. From the top row to the bottom row: original video frames, foreground masks after background subtraction, traffic flow masks, respectively.

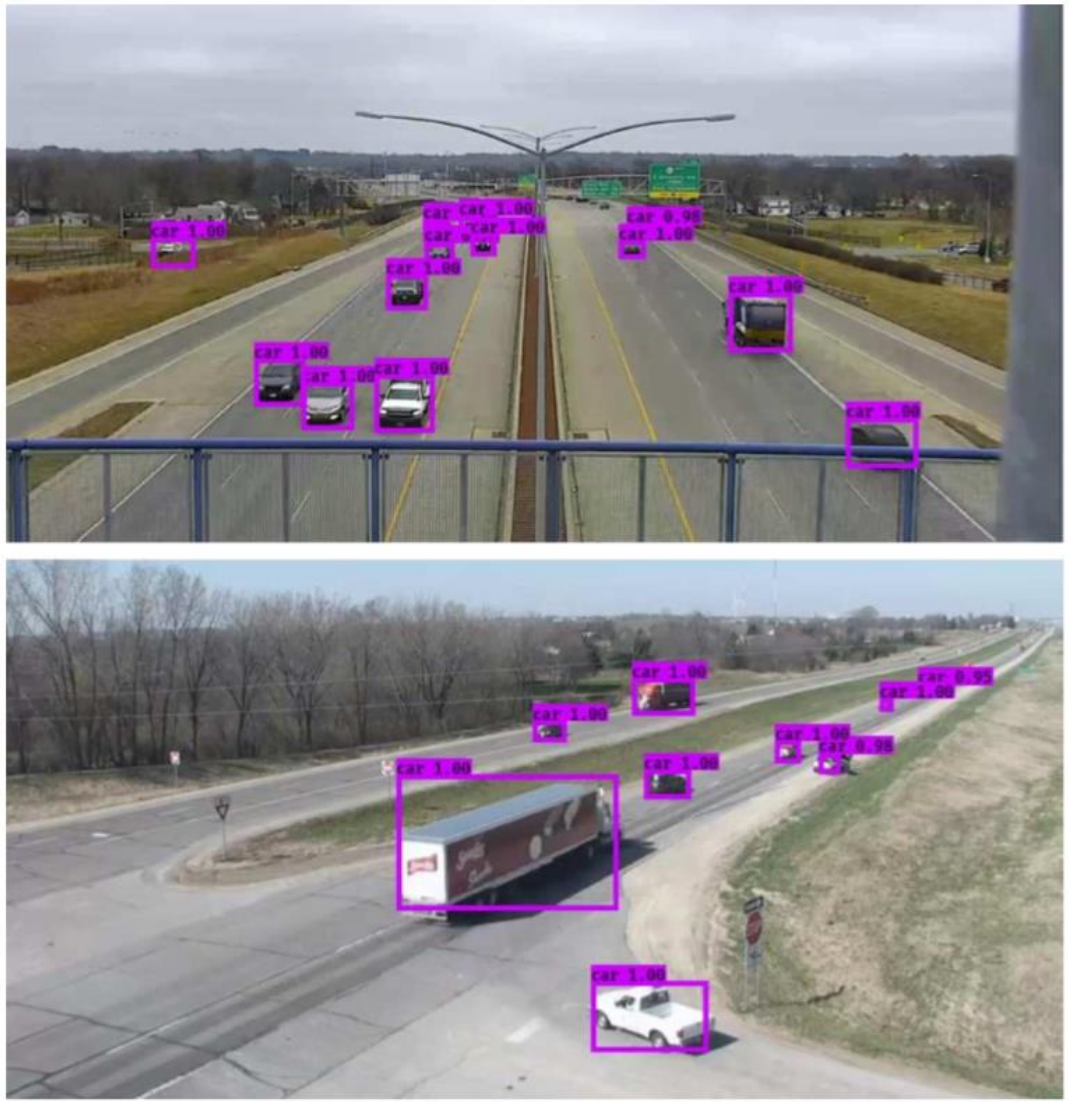

Figure 3. Examples of YOLOv3 detection results.

2. Proposed Method

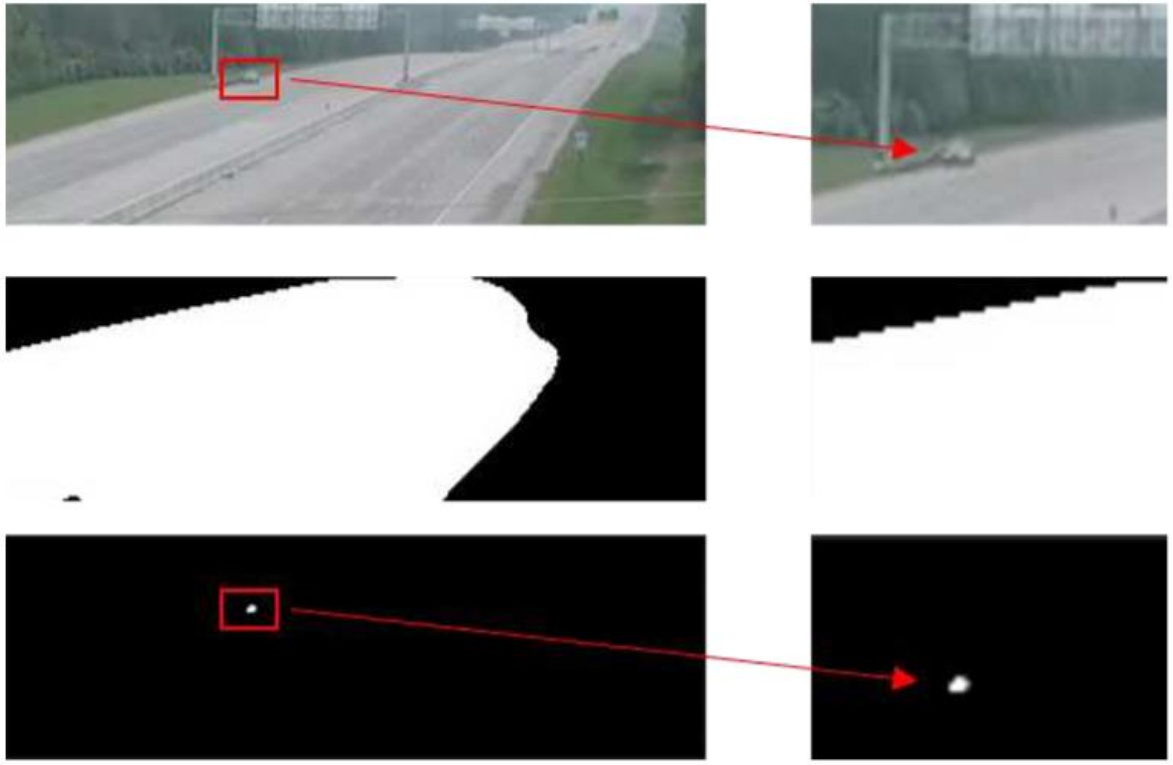

Figure 4. Examples of small vehicle detection. Top row: an example of an anomaly vehicle far away from the camera. Middle row: the generated traffic flow mask. Bottom row: the detected anomaly vehicle using frame subtraction. The figures in the right column are the zoom-ins of the figures in the left column.

2. Proposed Method

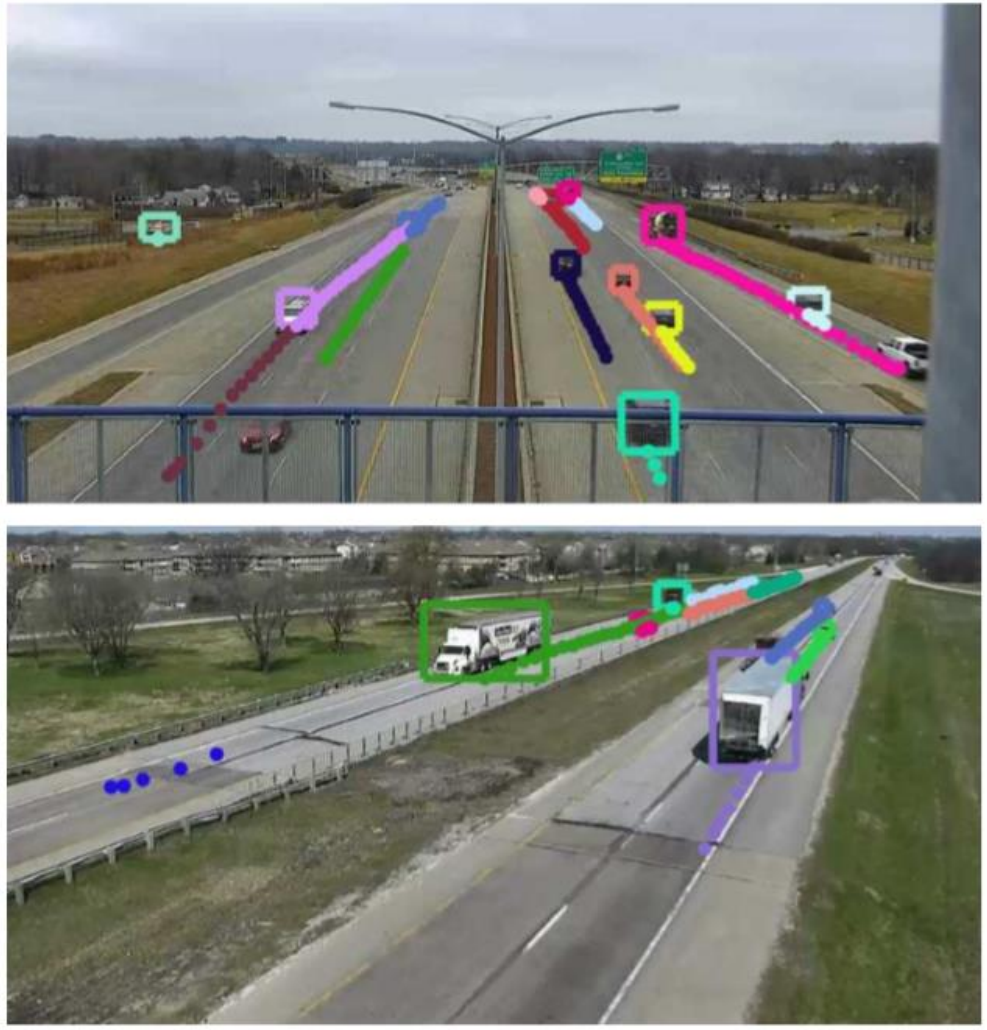

Figure 6. Examples of multi-object tracking with TNT. Each color represents a unique tracked vehicle ID. Dots are vehicle locations detected in the previous frames.

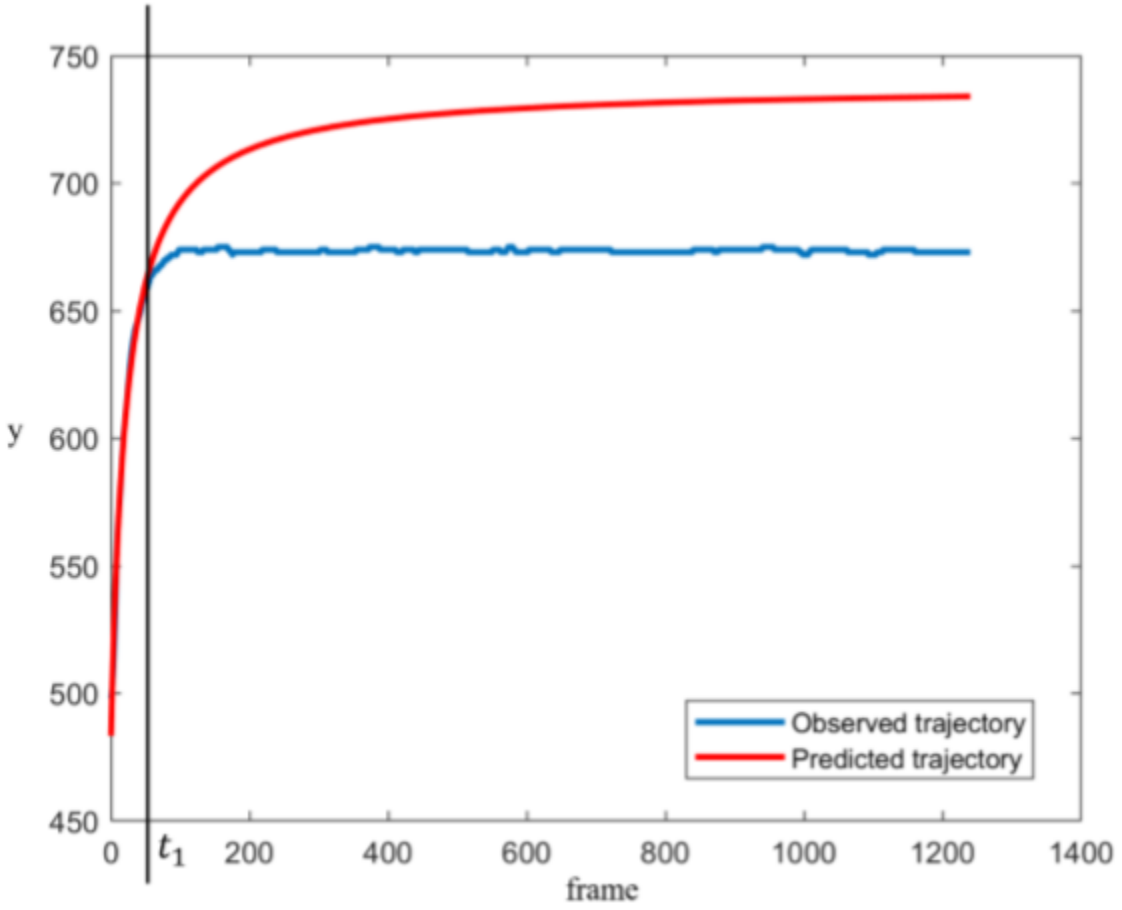

Figure 7. An example of the curve fitting.

3. Experiments

AI City 2019 dataset

Self-recorded dataset

VisDrone dataset

Dataset from STAR Lab

Figure 8. Examples of the dataset used for training the YOLOv3 detector.

AI City 2018 dataset

3. Experiments

Figure 9. Examples of detected anomalies. Left column: the original video frames. Right column: the corresponding processed video frames with detected anomalies shown with red bounding boxes from background regions. Other vehicles are smoothed out using our proposed method.

3. Experiments

$$S3 = F1(1 - NRMSE).$$

$$F1 = \frac{2TP}{2TP + FP + FN}.$$

$$NRMSE = \frac{\min\left\{\sqrt{\frac{1}{TP}\sum_{i=1}^{TP}(t_i - t_i^{GT})^2}, 300\right\}}{300}.$$

Rank	Team ID	Team Name	S3 Score
1	12	Traffic Brain	0.9534
2	**21**	**UWIPL**	**0.9362**
3	66	Spartans	0.8504
4	53	Desire	0.7598
5	24	Avengers5	0.7562
6	79	Alpha	0.6997
7	48	BUPT-MCPRL	0.6585
8	113	HCMUS	0.6129
9	36	DGRC	0.4337
10	158	TITAN LAB	0.4083

Table 1. The final ranking and S3 score on Track 3. Our team is shown in bold type.

F1	RMSE	S3 Score
0.9577	6.7461	0.9362

Table 2. The F1 sore and RMSE of the proposed method on the testing data.

4. Conclusion

- Traffic videos에서 Vehicles 이상 탐지와 이상 시작 추정을 위한 2단계 프레임 워크 제안
  1) Gaussian mixture models(GMMs): 전경 마스크 + 배경 이미지 생성 => 이상 객체 식별
     - Unsupervised approach로 이상 탐지를 위해 ROI(region of interest)를 사용
  2) TrackletNet Tracker(TNT): 이상 객체에 대한 trajectory를 계산하여 시간을 추정
- Track 3 testing set of CVPR AI City Challenge 2019 City Flow dataset => S3 score performance of 93.62%

Thank you!