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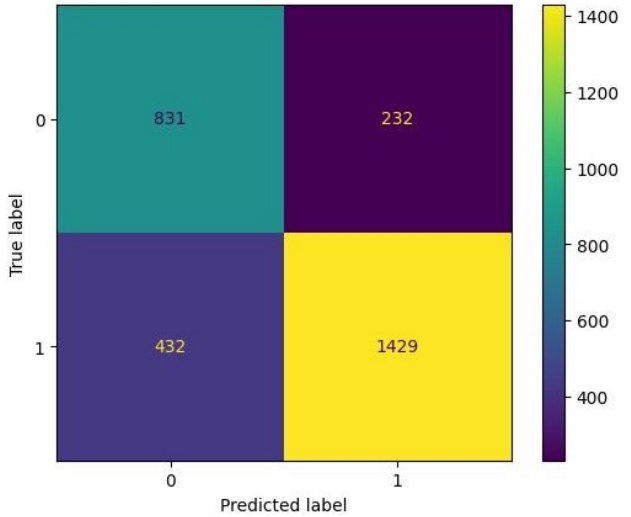
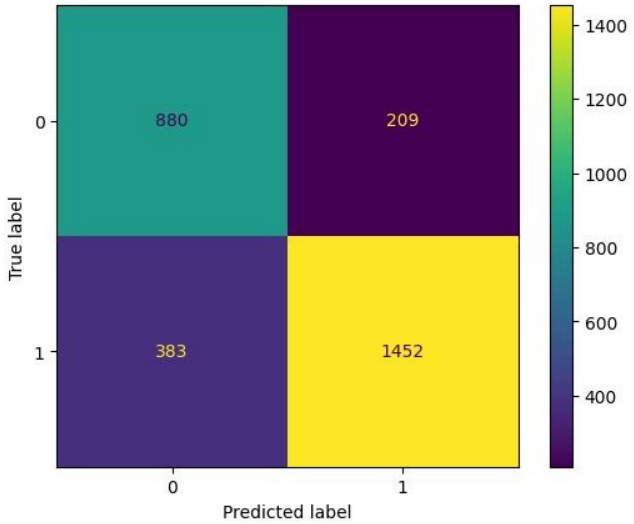
# LAMPIRAN

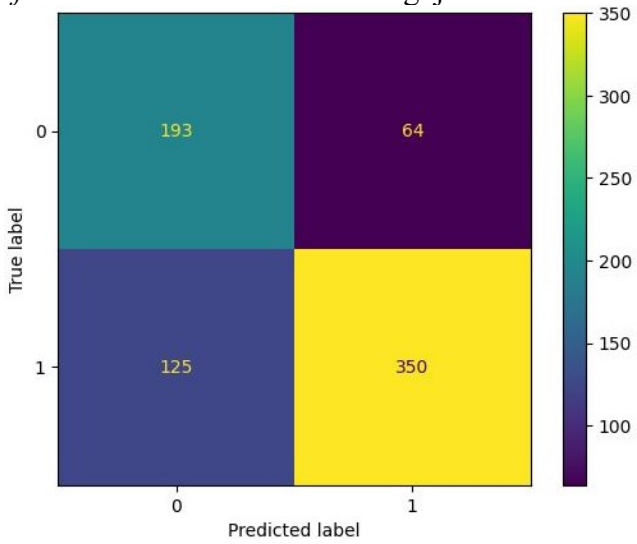
**Lampiran 1** *Confusion Matrix* SVM untuk Pembelajaran K-fold 5



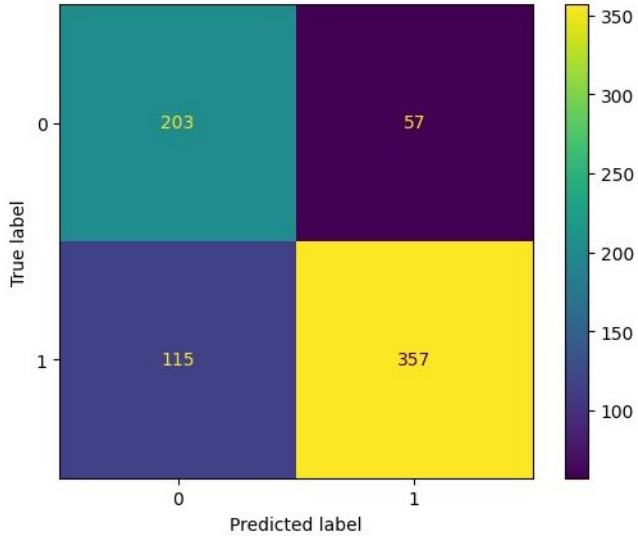

**Lampiran 2** *Confusion Matrix* SVM untuk Pembelajaran K-fold 10



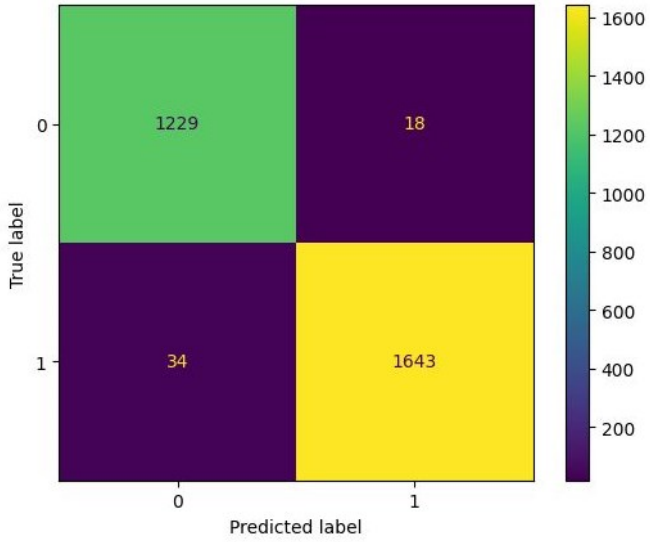

**Lampiran 3** *Confusion Matrix* SVM untuk Pengujian K-fold 5



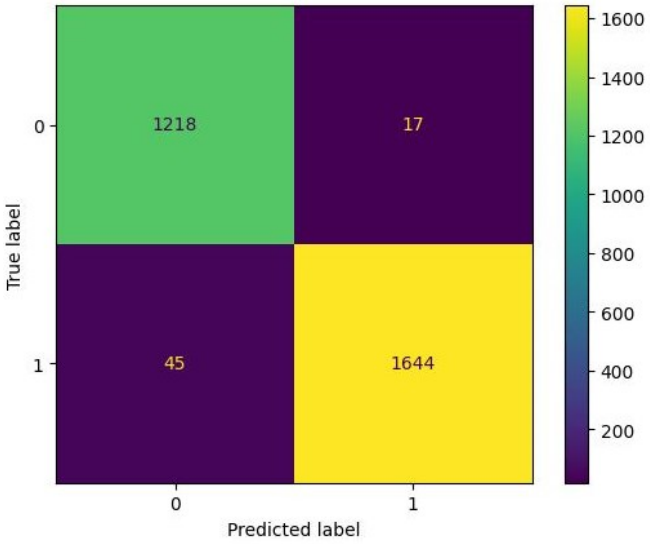
**Lampiran 4** *Confusion Matrix* SVM untuk Pengujian K-fold 10



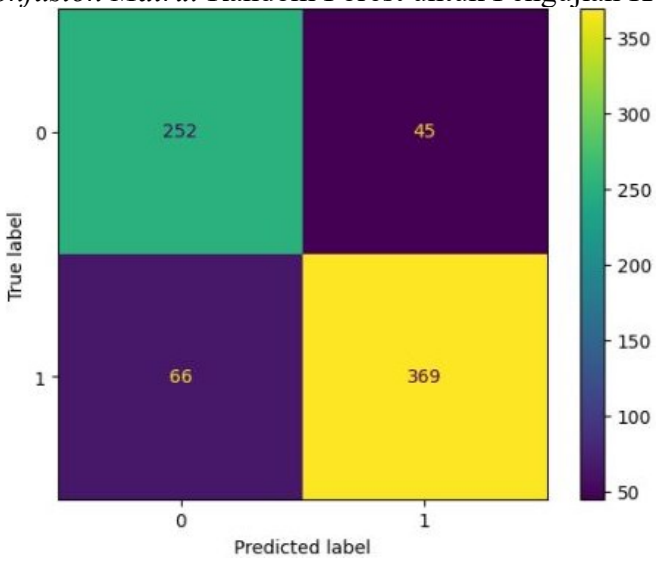

**Lampiran 5** *Confusion Matrix* Random Forest untuk Pembelajaran K-fold 5



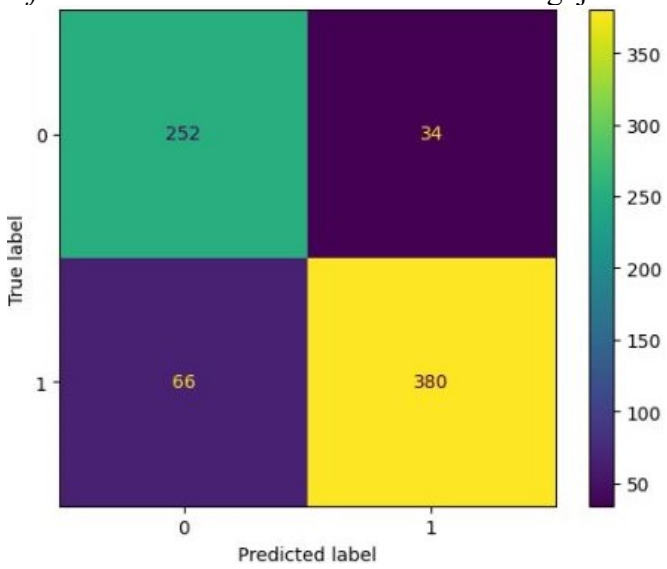

**Lampiran 6** *Confusion Matrix* Random Forest untuk Pembelajaran K-fold 10



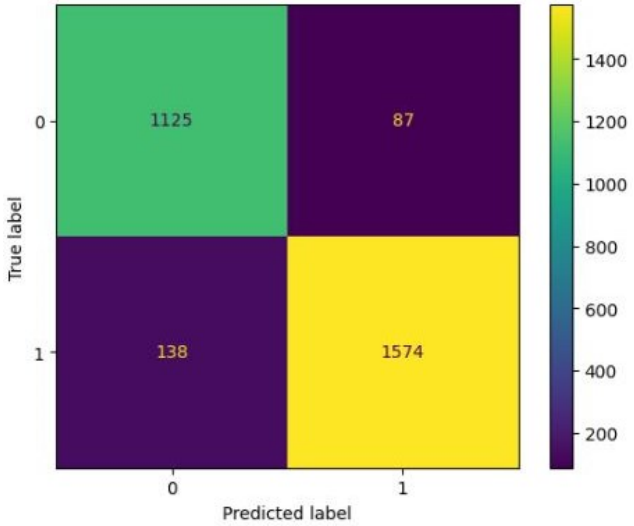
**Lampiran 7** *Confusion Matrix* Random Forest untuk Pengujian K-fold 5



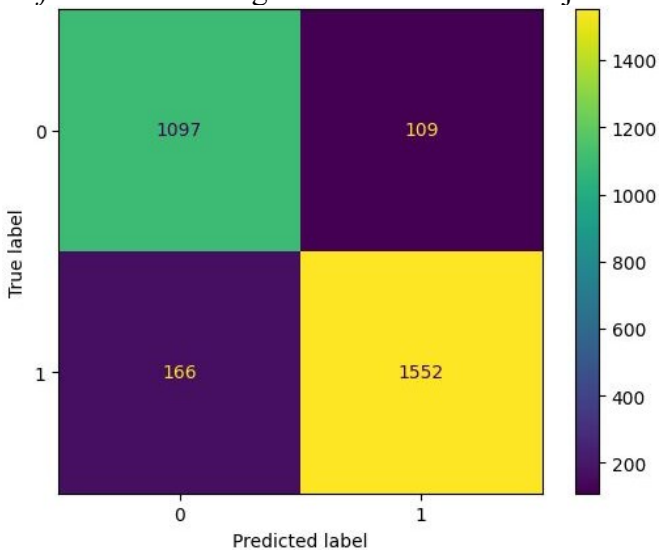

**Lampiran 8** *Confusion Matrix* Random Forest untuk Pengujian K-fold 10



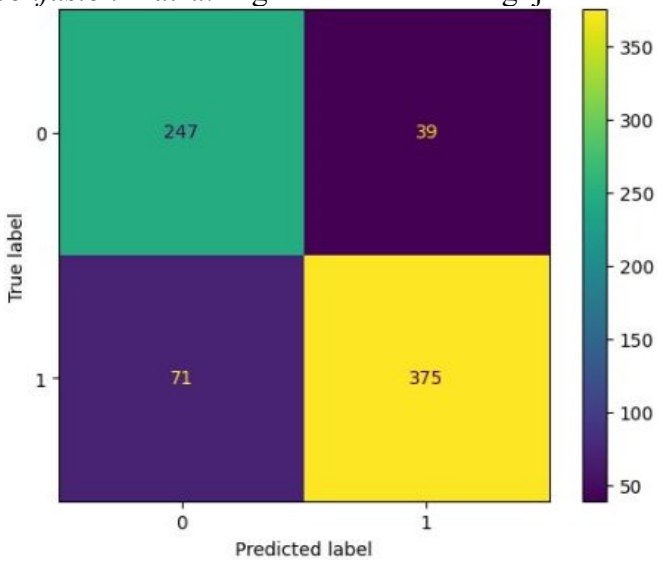

**Lampiran 9** *Confusion Matrix* LightGBM untuk Pembelajaran K-fold 5



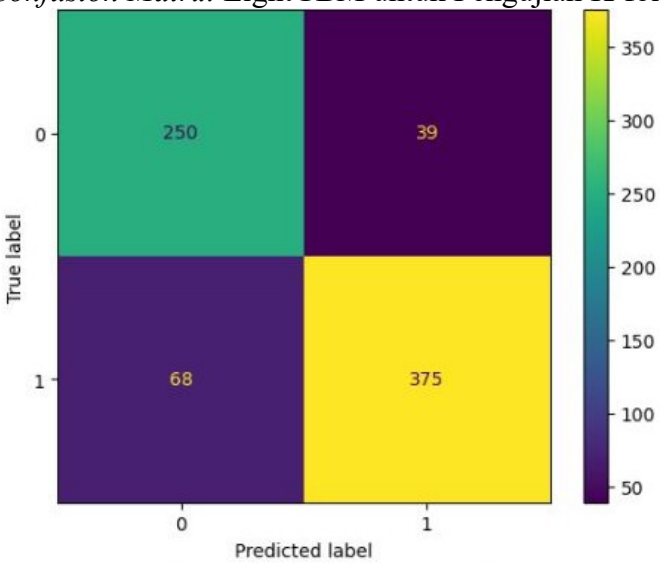
**Lampiran 10** *Confusion Matrix* LightGBM untuk Pembelajaran K-fold 10




**Lampiran 11** *Confusion Matrix* LightGBM untuk Pengujian K-fold 5




**Lampiran 12** *Confusion Matrix* LightGBM untuk Pengujian K-fold 10



**Lampiran 13** *Potongan frame kondisi lalu lintas pada video A01*


*Frame 119*

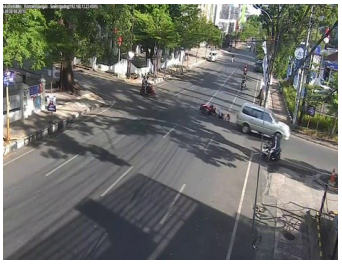

*Frame 123*


Frame 136

**Lampiran 14** *Potongan frame kondisi lalu lintas pada video A02*


*Frame 138*


Frame 171


Frame 181

**Lampiran 15** *Potongan frame kondisi lalu lintas pada video A03*

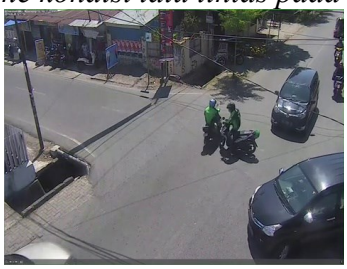
*Frame 169*

*Frame 177*

Frame 271

**Lampiran 16** *Potongan frame kondisi lalu lintas pada video A04*


*Frame 275*


*Frame 286*


Frame 305

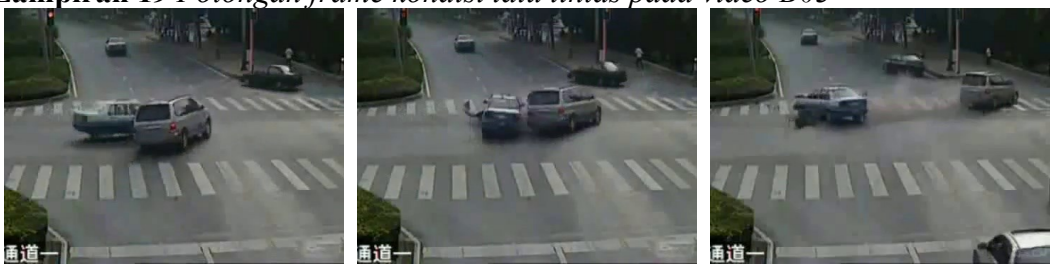
**Lampiran 17** *Potongan frame kondisi lalu lintas pada video B01*

*Frame 181* *Frame 188* Frame 216

**Lampiran 18** *Potongan frame kondisi lalu lintas pada video B02*

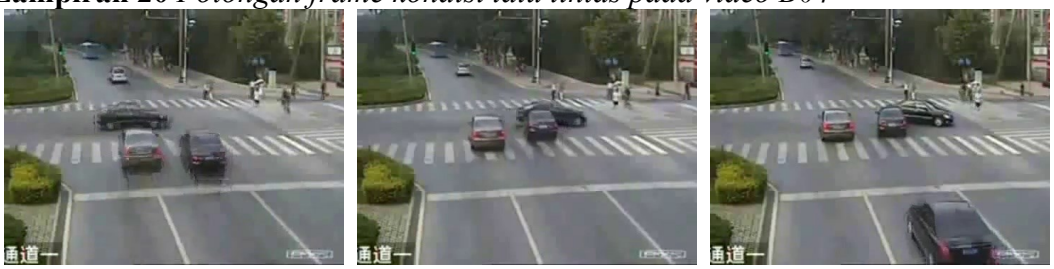
*Frame 309* Frame 321 Frame 345

**Lampiran 19** *Potongan frame kondisi lalu lintas pada video B03*



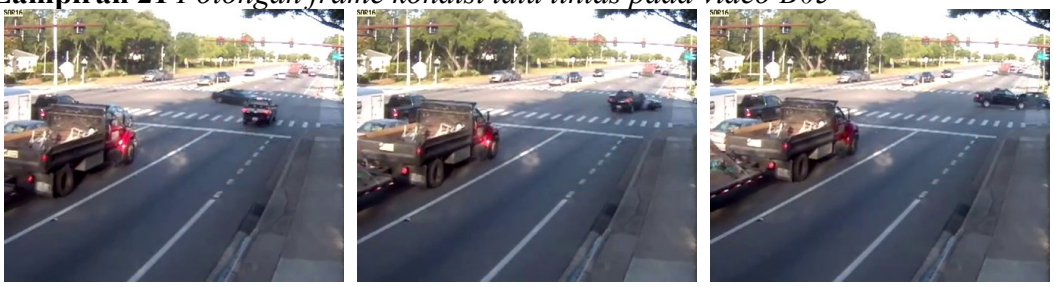
*Frame 178* Frame 191 Frame 220

**Lampiran 20** *Potongan frame kondisi lalu lintas pada video B04*



*Frame 250* Frame 275 Frame 311

**Lampiran 21** *Potongan frame kondisi lalu lintas pada video B05*

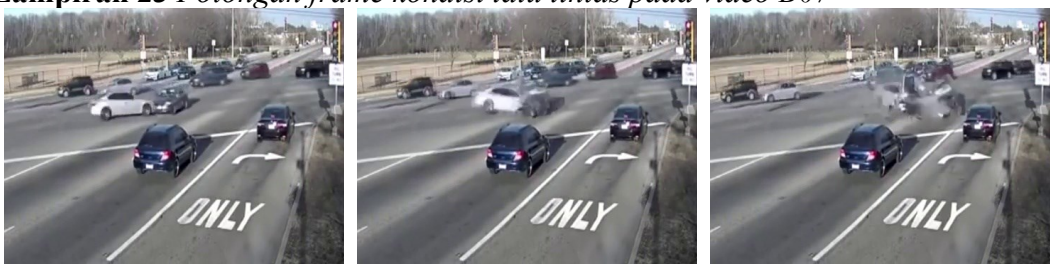


*Frame 138* Frame 151 Frame 170

**Lampiran 22** *Potongan frame kondisi lalu lintas pada video B06*

*Frame 191* *Frame 199* Frame 236

**Lampiran 23** *Potongan frame kondisi lalu lintas pada video B07*



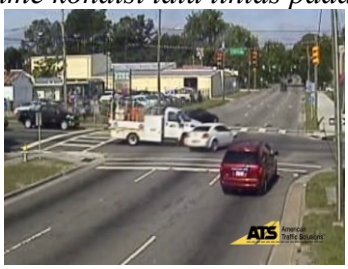

*Frame 400* Frame 404 Frame 412

**Lampiran 24** *Potongan frame kondisi lalu lintas pada video B08*

*Frame 31* Frame 41 Frame 61

**Lampiran 25** *Potongan frame kondisi lalu lintas pada video B09*


*Frame 61*


Frame 73


Frame 86

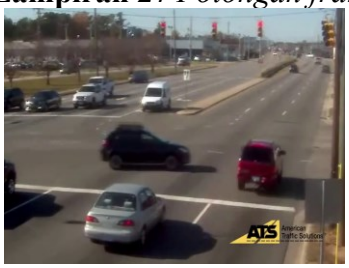
**Lampiran 26** *Potongan frame kondisi lalu lintas pada video B10*

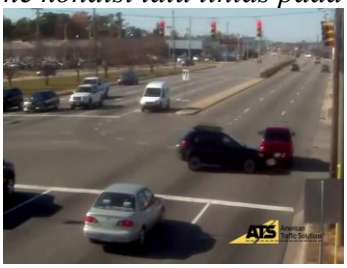

*Frame 31*

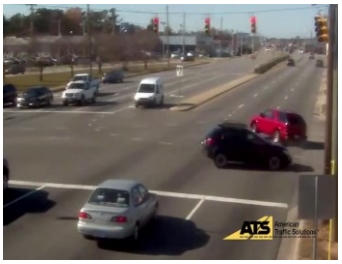

Frame 61


Frame 86

**Lampiran 27** *Potongan frame kondisi lalu lintas pada video B11*


*Frame 41*


*Frame 56*


Frame 71

**Lampiran 28** *Potongan frame kondisi lalu lintas pada video B12*


*Frame 66*


Frame 76


Frame 91

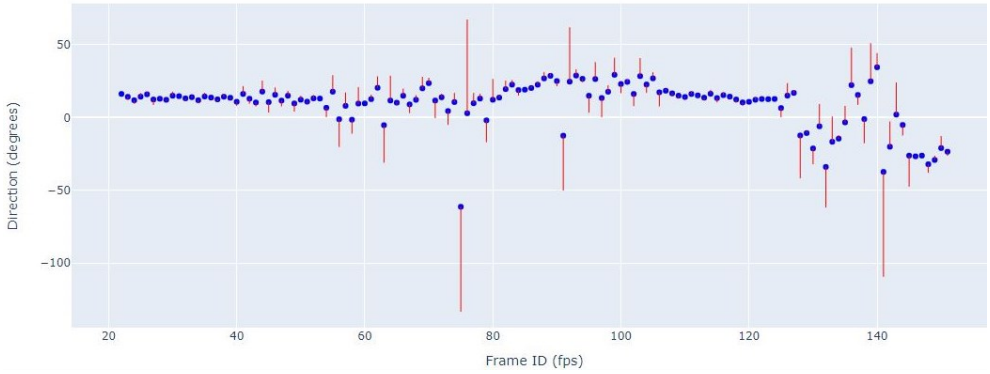
**Lampiran 29** *Potongan frame kondisi lalu lintas pada video B13*

*Frame 38* Frame 63 Frame 76

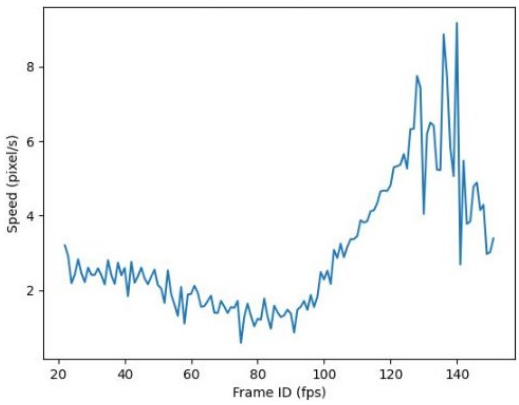
**Lampiran 30** *Potongan frame kondisi lalu lintas pada video B14*

*Frame 51* Frame 71 Frame 96

**Lampiran 31** *Pola berkendara objek ID A01_2*

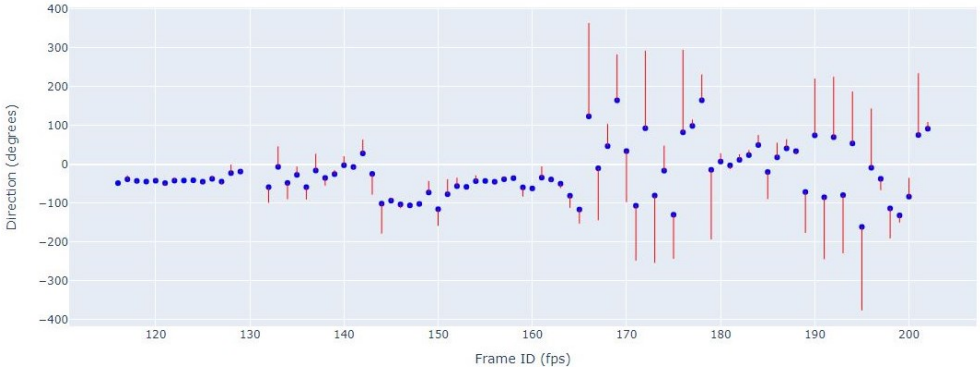



Fitur Arah

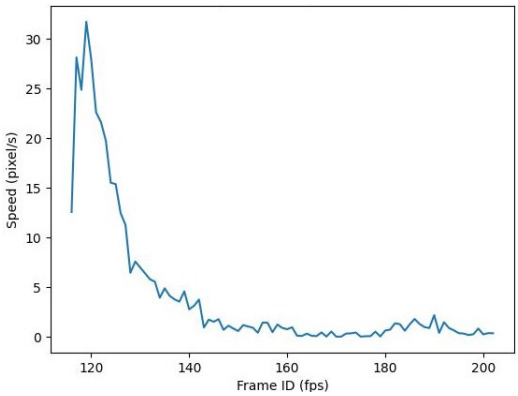



Fitur Kecepatan

**Lampiran 32** *Pola berkendara objek ID A01 7*

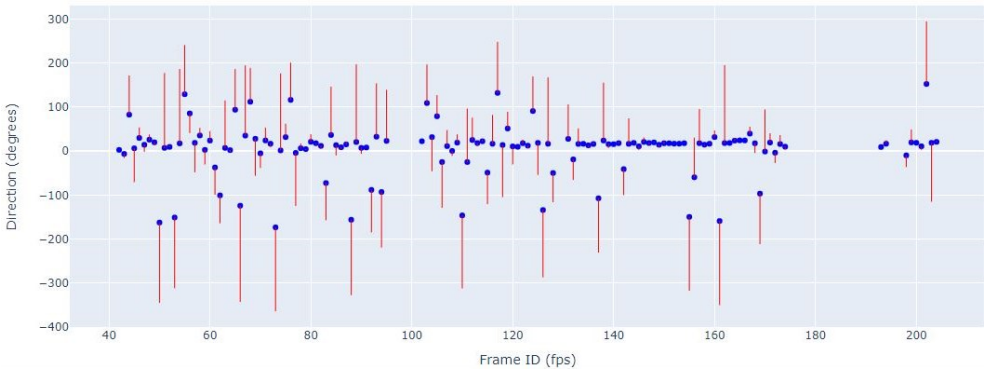



Fitur Arah

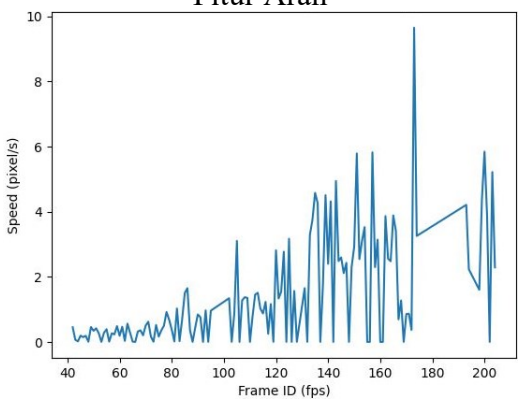



Fitur Kecepatan

**Lampiran 33** *Pola berkendara objek ID A02 5*

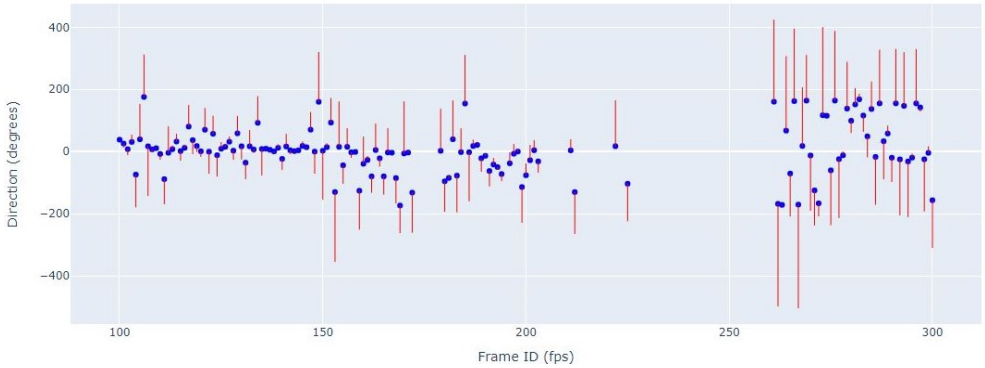



Fitur Arah

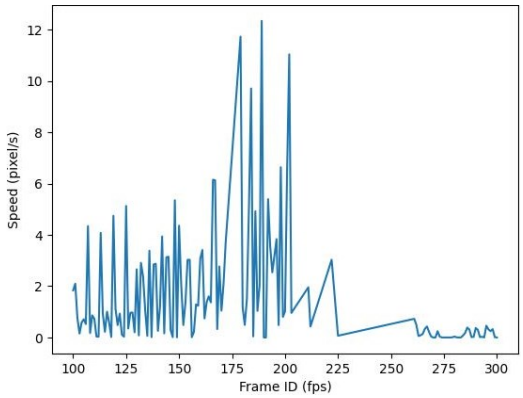



Fitur Kecepatan

**Lampiran 34** *Pola berkendara objek ID B01_6*

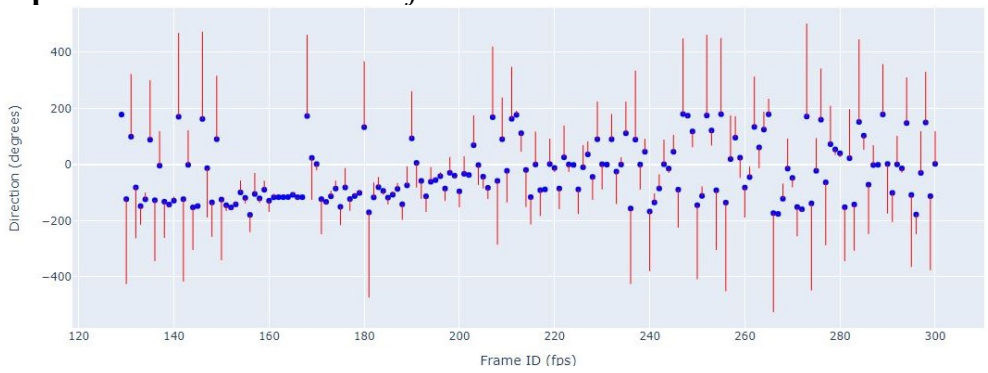



Fitur Arah

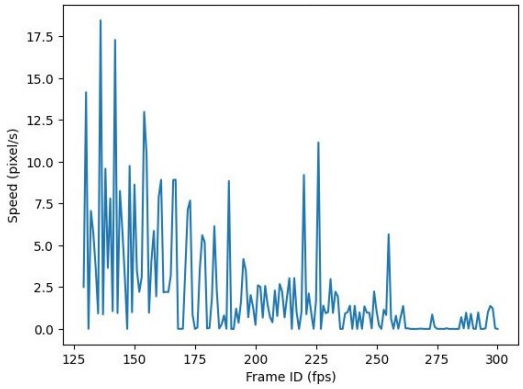



Fitur Kecepatan

**Lampiran 35** *Pola berkendara objek ID B01_8*

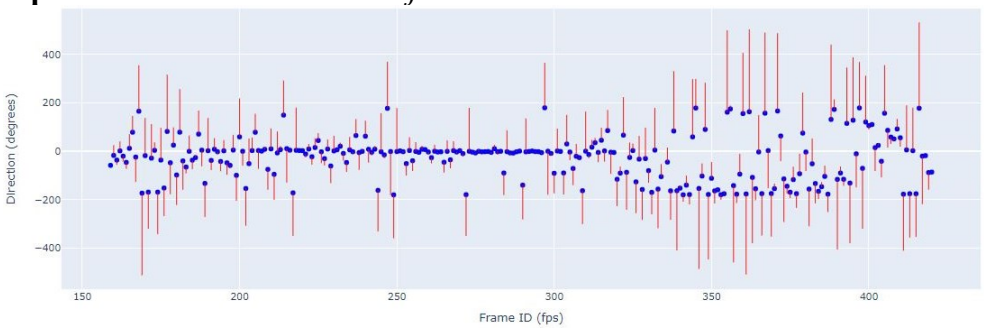



Fitur Arah

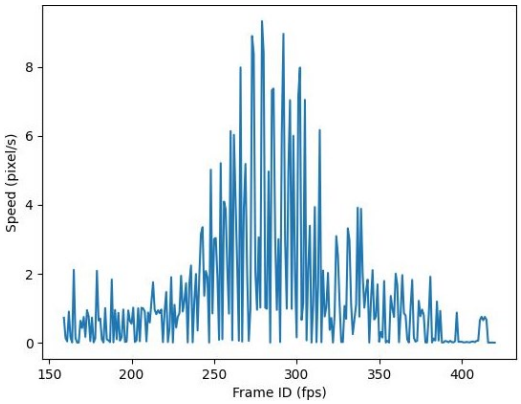



Fitur Kecepatan

**Lampiran 36** *Pola berkendara objek ID B02_11*

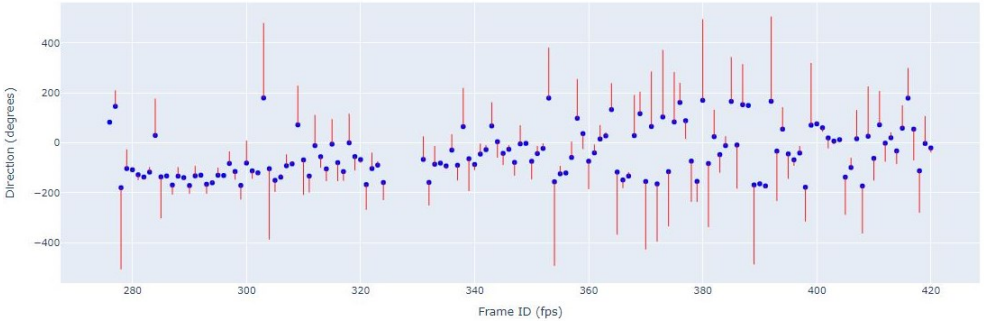



Fitur Arah

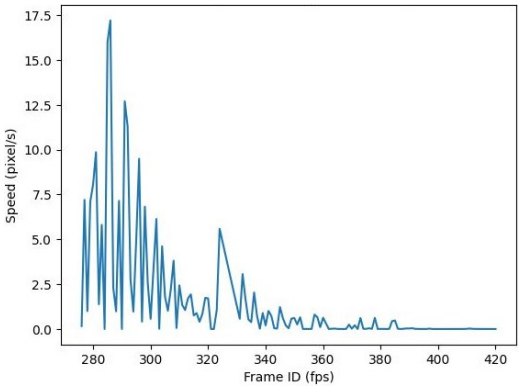



Fitur Kecepatan

**Lampiran 37** *Pola berkendara objek ID B02_14*

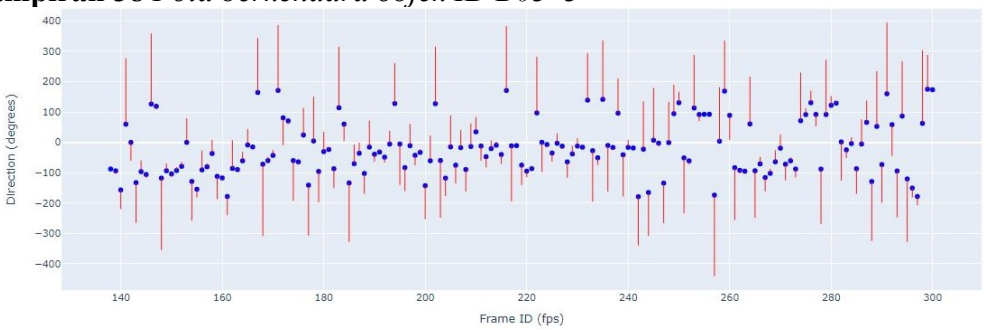



Fitur Arah

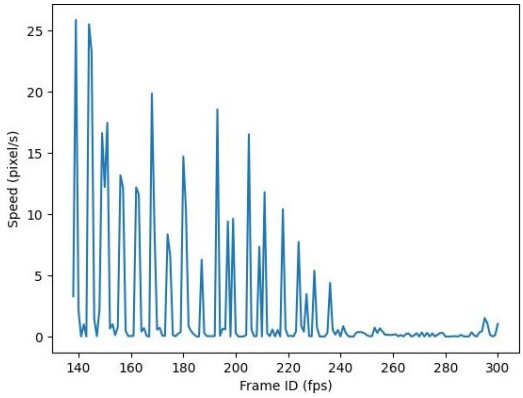



Fitur Kecepatan

**Lampiran 38** *Pola berkendara objek ID B03  3*

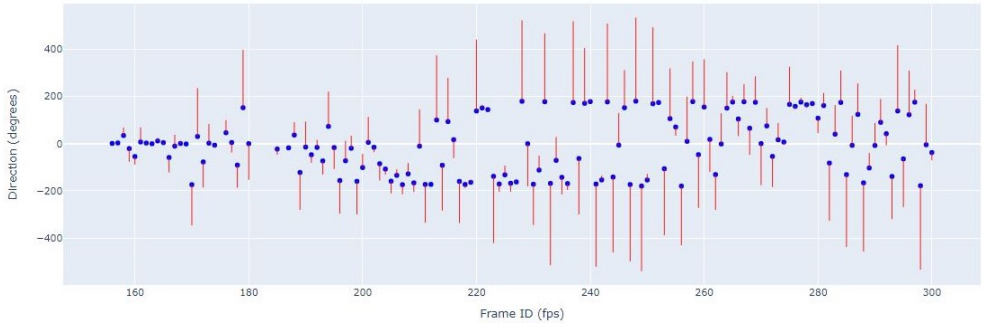



Fitur Arah

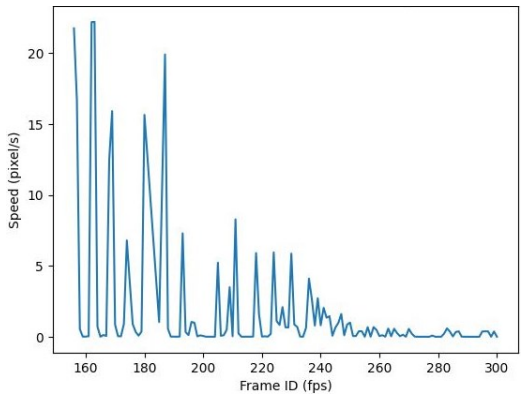



Fitur Kecepatan

**Lampiran 39** *Pola berkendara objek ID B03  4*

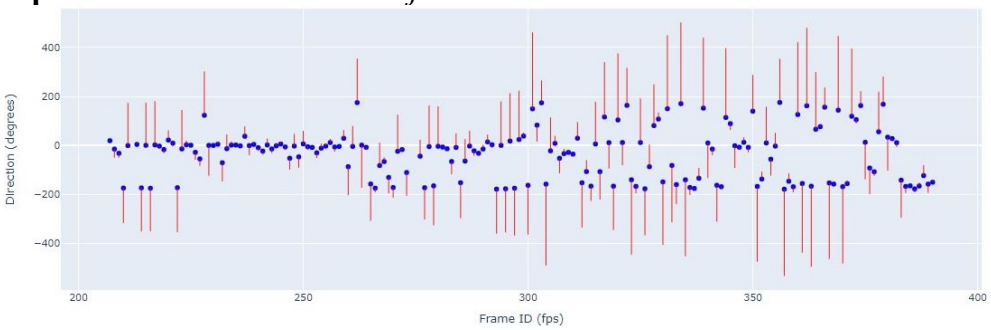



Fitur Arah

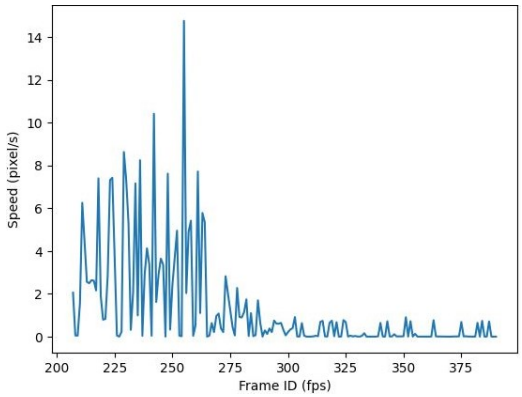



Fitur Kecepatan

**Lampiran 40** *Pola berkendara objek ID B04_6*

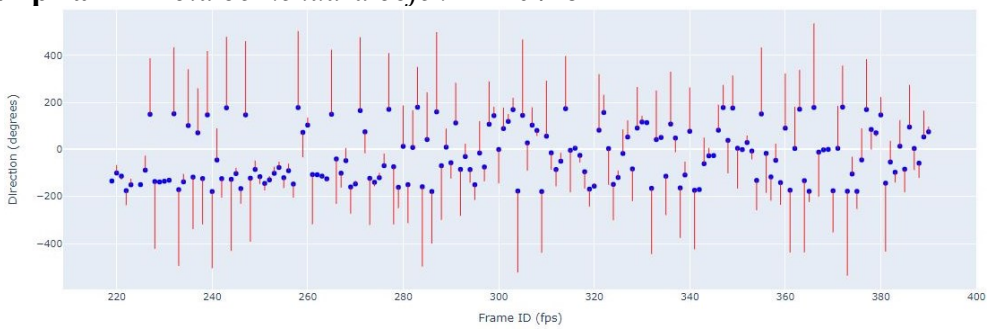



Fitur Arah

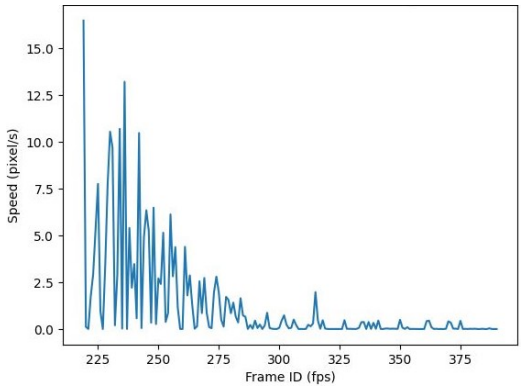



Fitur Kecepatan

**Lampiran 41** *Pola berkendara objek ID B04_8*

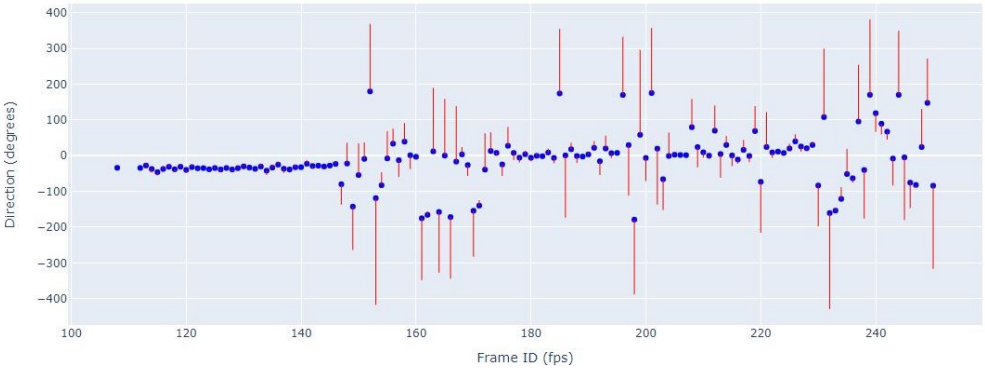



Fitur Arah

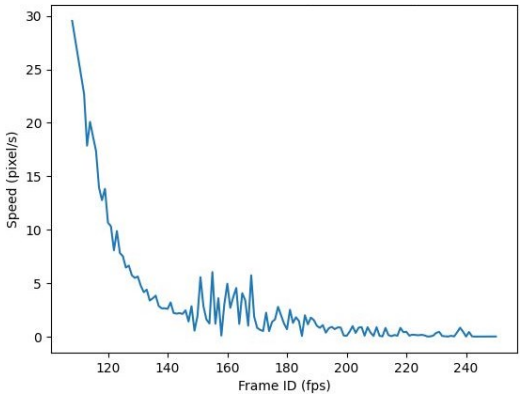



Fitur Kecepatan

**Lampiran 42** *Pola berkendara objek ID B05_9*

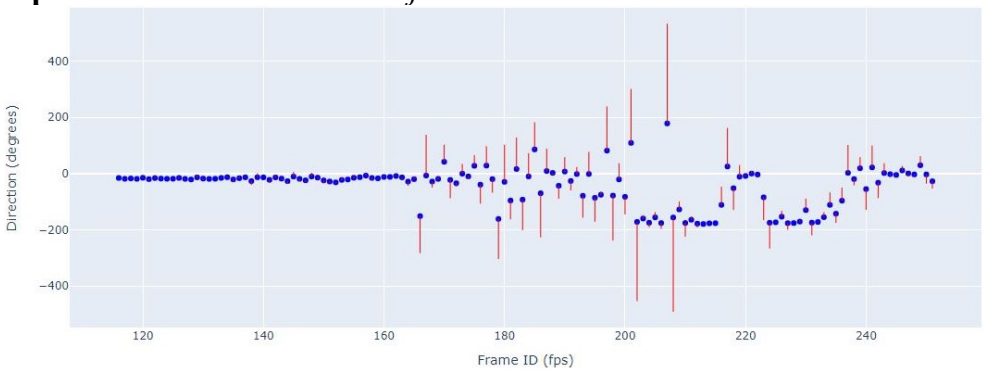



Fitur Arah

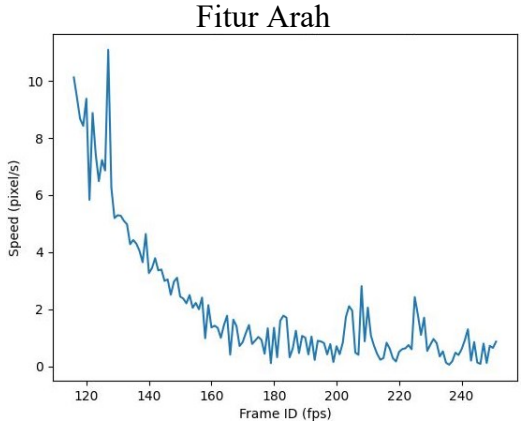



Fitur Kecepatan

**Lampiran 43** *Pola berkendara objek ID B06_7*

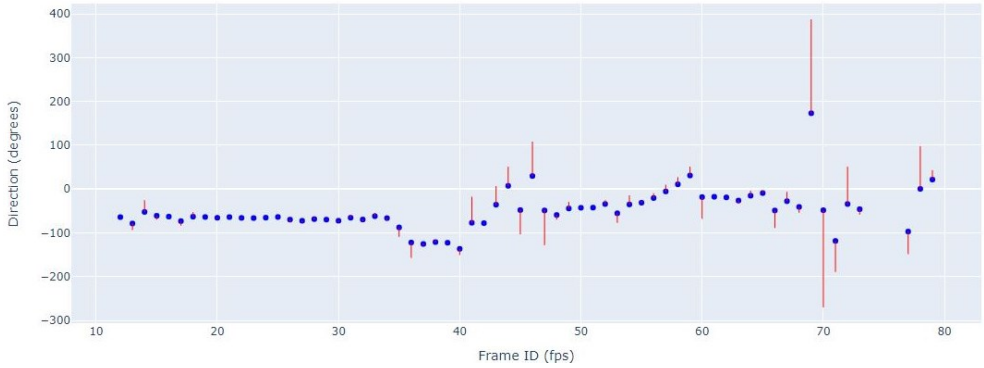



Fitur Arah

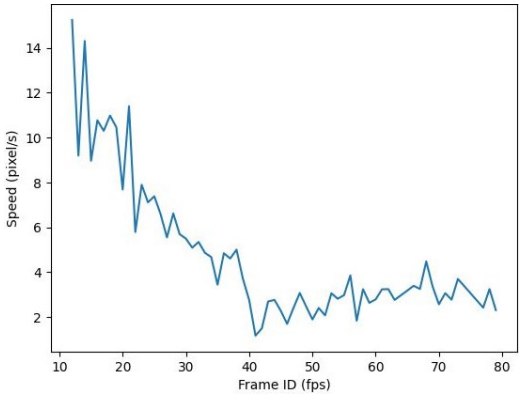



Fitur Kecepatan

**Lampiran 44** *Pola berkendara objek ID B08_3*

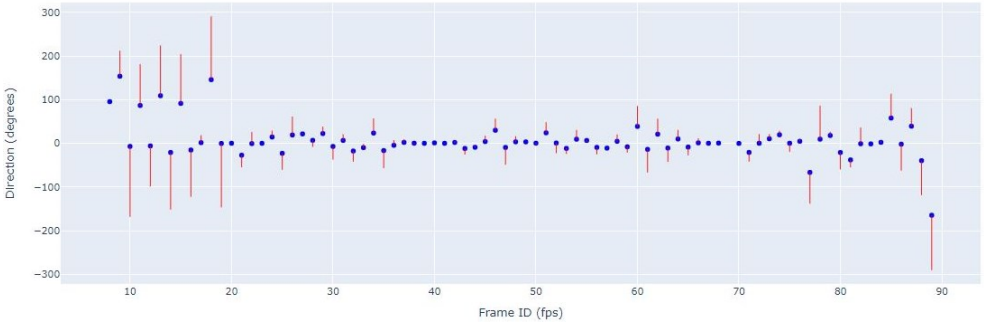



Fitur Arah

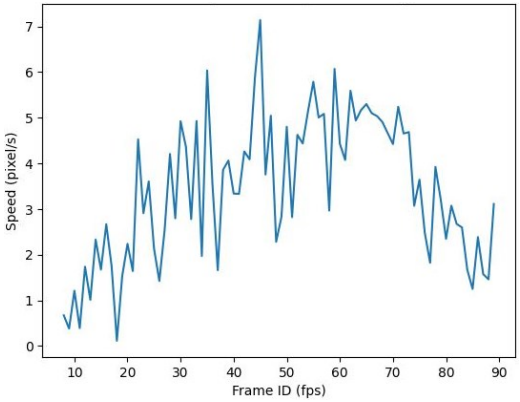



Fitur Kecepatan

**Lampiran 45** *Pola berkendara objek ID B09_3*

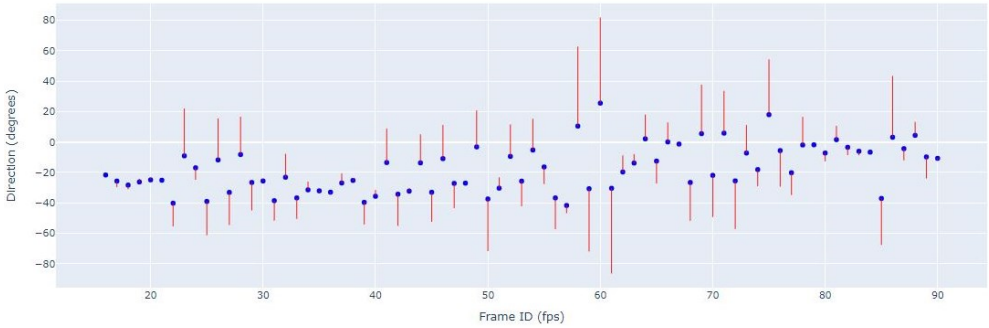



Fitur Arah

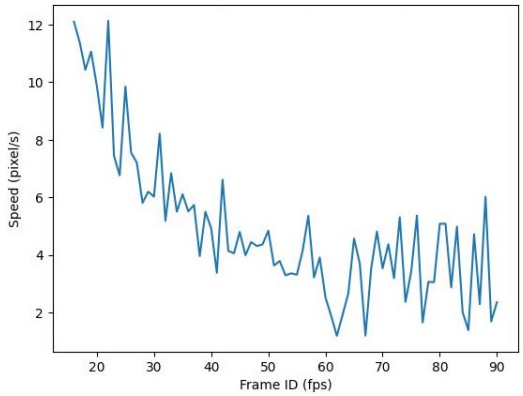



Fitur Kecepatan

**Lampiran 46** *Pola berkendara objek ID B10  6*

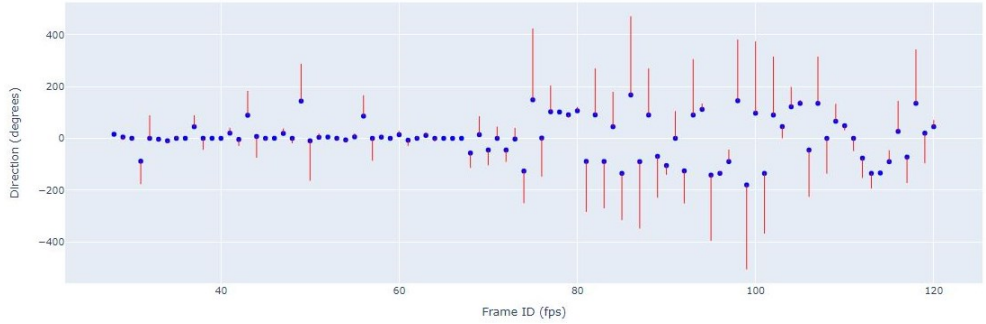



Fitur Arah

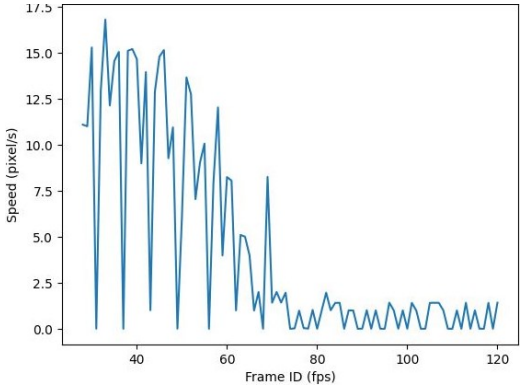



Fitur Kecepatan

**Lampiran 47** *Pola berkendara objek ID B11  8*

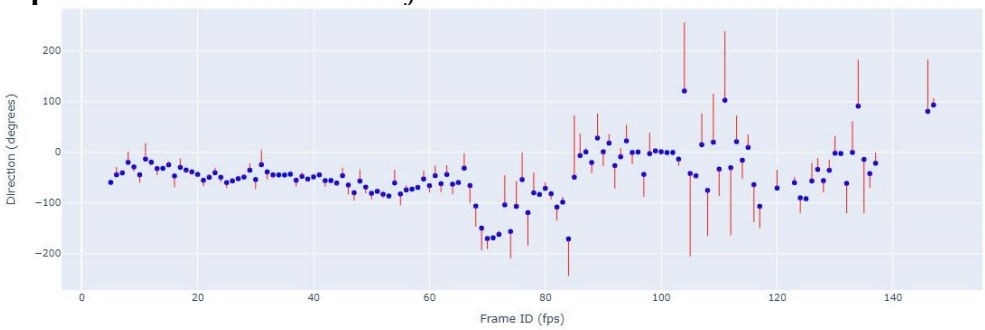



Fitur Arah

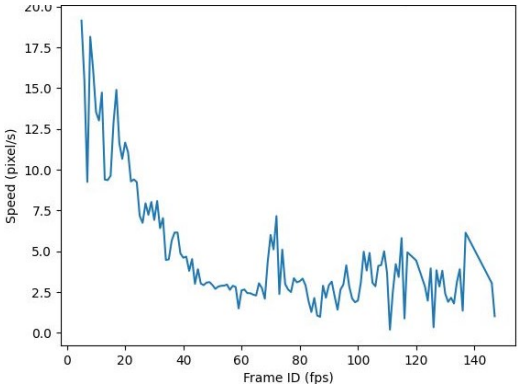



Fitur Kecepatan

**Lampiran 48** *Pola berkendara objek ID B12  3*

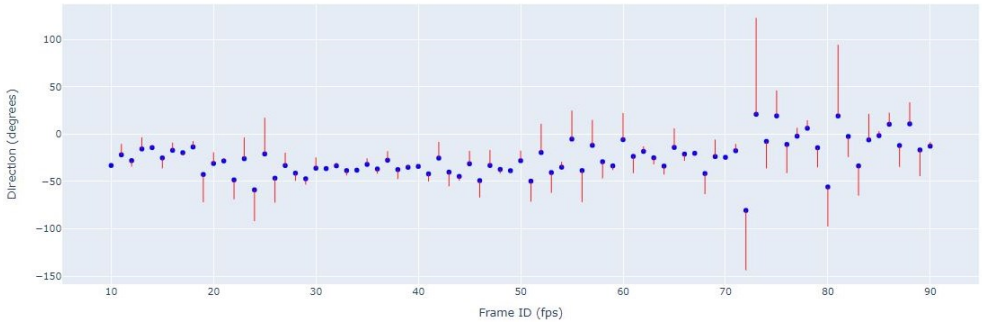



Fitur Arah

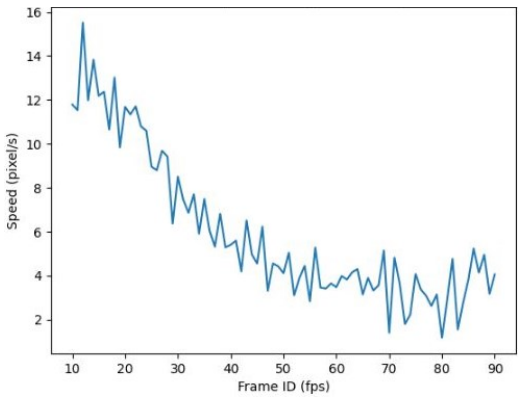



Fitur Kecepatan

**Lampiran 49** *Pola berkendara objek ID B13  7*

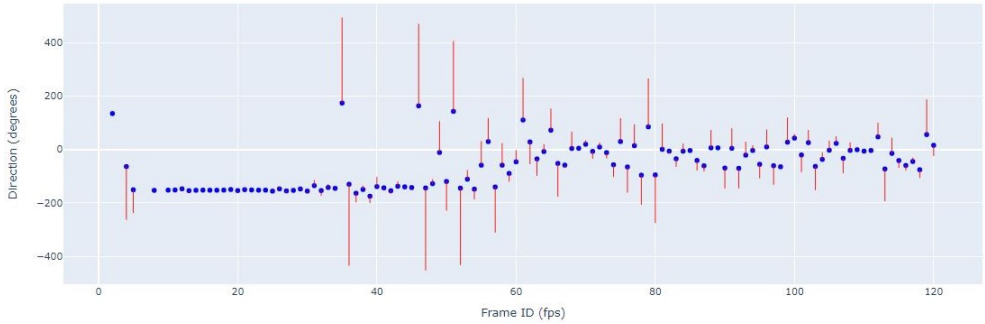



Fitur Arah

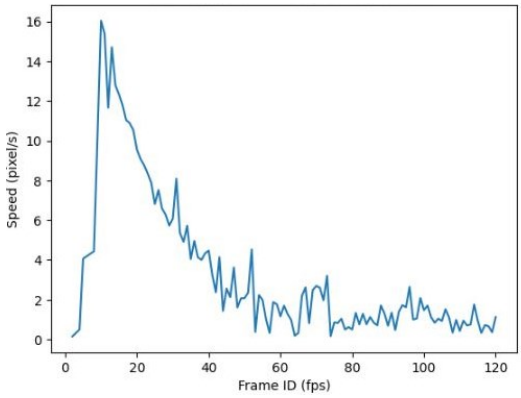



Fitur Kecepatan

**Lampiran 50** *Pola berkendara objek ID B14  1*




Fitur Arah




Fitur Kecepatan

**Lampiran 51** *Contoh code proses deteksi objek dengan model YOLOv5s*

```
    # Draw bounding boxes and labels on the frame
    for (x, y, w, h) in filtered_boxes:
        # Draw bounding box rectangle
        cv2.rectangle(frame, (x, y), (x + w, y + h), (0, 255, 0), 2)

    return frame, filtered_boxes

# Load the YOLOv5 model
# model = torch.hub.load('ultralytics/yolov5', 'yolov5s')
# model.eval()

# Modify the video_path according to the location of the video you want to detect
video_path = "/content/drive/MyDrive/YOLOV5/video/18_SIANG_ANTAR MOTOR_TABRAK_BLUR 1.mp4"
output_path = "/content/drive/MyDrive/YOLOV5/percobaan/output_video18.mp4"  # Path to save the output video

cap = cv2.VideoCapture(video_path)
fps = cap.get(cv2.CAP_PROP_FPS)
width = int(cap.get(cv2.CAP_PROP_FRAME_WIDTH))
height = int(cap.get(cv2.CAP_PROP_FRAME_HEIGHT))
fourcc = cv2.VideoWriter_fourcc(*'mp4v')
out = cv2.VideoWriter(output_path, fourcc, fps, (width, height))

# Initialize count
count = 0
center_points_prev_frame = []

tracking_objects = {}
track_id = 1
```

**Lampiran 52** *Contoh code proses pemberian ID kendaraan*

```
# Increment idle frames for unmatched objects and remove objects with too many idle frames
tracking_objects_copy = tracking_objects.copy()
for object_id in tracking_objects_copy.keys():
    if object_id not in matched_ids:
        idle_frames[object_id] += 1
        if idle_frames[object_id] > max_idle_frames:
            tracking_objects.pop(object_id)
            idle_frames.pop(object_id)

# Assign new IDs to unmatched objects
for pt in center_points_cur_frame:
    if pt[1] > 50:
        # Check if the object is a shadow or irrelevant object based on width-to-height ratio
        is_shadow = False
        width_height_ratio = pt[0] / pt[1]
        if width_height_ratio > 3 or width_height_ratio < 0.3:
            is_shadow = True

        # Find the smallest available ID
        if not is_shadow:
            while track_id in tracking_objects:
                track_id += 1
            tracking_objects[track_id] = pt
            idle_frames[track_id] = 0
            matched_ids.append(track_id)
            track_id += 1
```

**Lampiran 53** *Contoh code proses pelacakan fitur menggunakan Farneback*

```
    # Calculate optical flow
    flow = cv2.calcOpticalFlowFarneback(prev_gray, curr_gray, None, 0.5, 3, 15, 3, 5, 1.2, 0)

    # Update tracking results with optical flow
    for object_id, pt in tracking_objects.items():
        if object_id in matched_ids:
            # Get the coordinates for optical flow calculation
            x = int(pt[0])
            y = int(pt[1])
            dx = flow[y, x, 0]
            dy = flow[y, x, 1]

            # Calculate speed and direction
            speed = math.sqrt(dx**2 + dy**2)
            angle = math.atan2(dy, dx) * 180 / math.pi

            # Write tracking results to CSV file
            csv_writer.writerow([count, object_id, speed, angle, 0])
```

**Lampiran 54** *Contoh code proses klasifikasi menggukan SVM Gaussian RBF*

```
# import HalvingGridSearchCV
from sklearn.experimental import enable_halving_search_cv  # Perlu diimpor untuk mengaktifkan fitur ini
from sklearn.model_selection import HalvingGridSearchCV
from sklearn.svm import SVC

# instantiate classifier with default hyperparameters
svc = SVC()

# declare parameters for hyperparameter tuning

parameters = {'C': [0.1, 1, 10, 100, 1000],
              'gamma': [1, 0.1, 0.01, 0.001, 0.0001],
              'kernel': ['rbf','linear'],
              'degree':[1,2,3,4,5,6]}

SVM = HalvingGridSearchCV(estimator=svc,
                                    param_grid=parameters,
                                    scoring='accuracy',
                                    cv=5,
                                   random_state=0,
                                    factor=3,
                                    verbose=2)

SVM.fit(X_train, y_train)

print("Best parameters found:")
print(SVM.best_params_)
print("Best accuracy found:", SVM.best_score_)
```