01

March 28, 2018

1 Assignment 1

1.1 Exercise 1.1

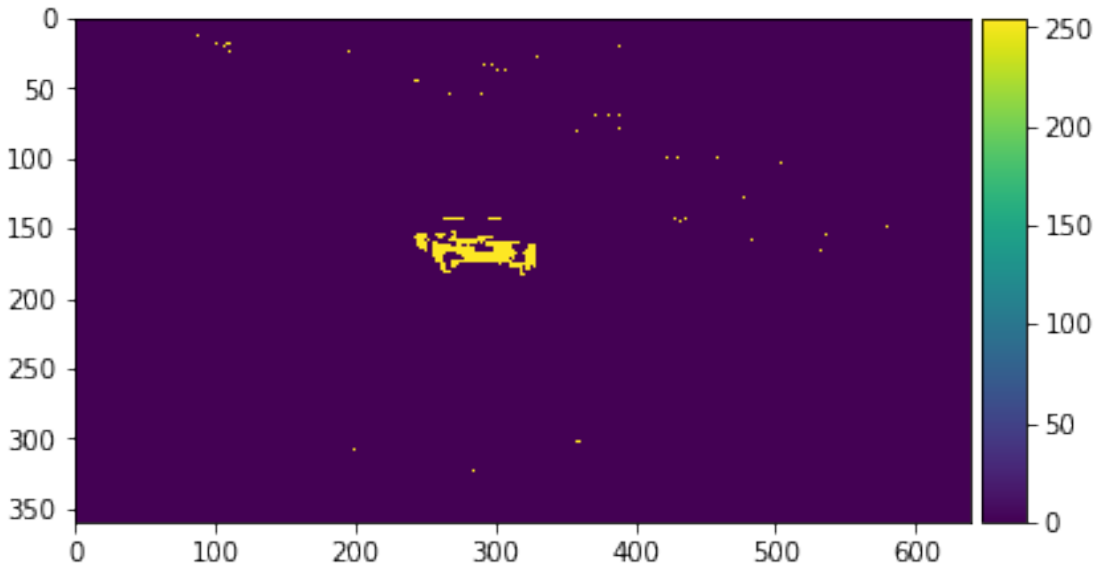
rough sketch for ex 1.2:

1. define the positive“ subspace P in the RGB cube
2. iterate over all pixels in I and check if in P or ~P
3. write result to new image
4. play around with size and shape of P and display binary image (**RESULT**)

```
In [14]: %matplotlib inline

         from skimage import io, data, color
         from skimage.morphology import erosion, disk, dilation, square
         import numpy as np
         import matplotlib.pyplot as plt
         import warnings; warnings.filterwarnings('ignore')

         image = io.imread('images/racecar/010.jpeg')
         height, width, _ = image.shape
         print(width, height)

         def create_mask(image, width, height):
             mask = np.zeros_like(image[:,:,0])

             for y in range(0,height):
                 for x in range(0,width):
                     rgb = [image[y,x,0], image[y,x,1], image[y,x,2]]
                     rgb.sort()
                     color_min = rgb[1] - 40
                     color_max = rgb[1] + 40

                     # filter greyish color
                     if (color_min < rgb[0] < color_max and color_min < rgb[2] < color_max):
                         continue

                     # get blue color
```

```
                if image[y,x,2] > 110 and image[y,x,0:1] < 220 :
                    mask[y,x] = 255

        return mask

    mask = create_mask(image, width, height)

    io.imshow(mask)
    io.show()
    # RESULT
```

```
640 360
```



1.2 Exercise 1.2

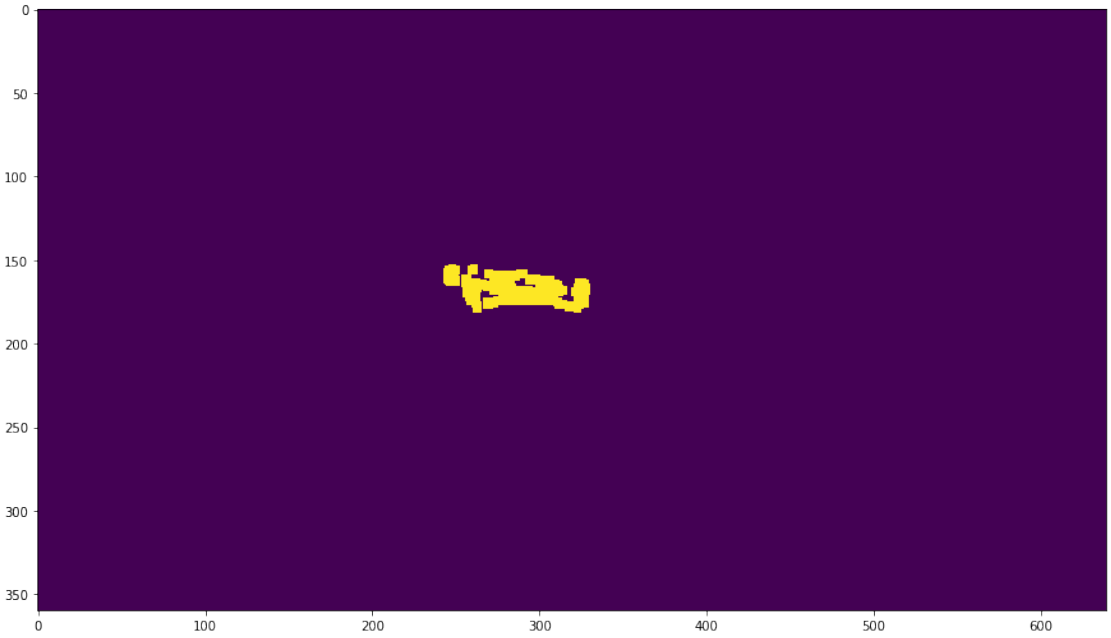
- starting from the binary color detection image
- erase noise with an erosion operation
- dilate once to get original size of object
- find connected components with one-pass algorithm
- extract bounding box on the fly
- draw bounding box on original image (**RESULT**)

```
In [4]: from skimage.draw import polygon_perimeter

    selem = square(3)
    eroded = erosion(mask, selem)
    dilated = dilation(eroded, selem)
```

```
dilated = dilation(dilated, selem)

mask = dilated
height, width = mask.shape

#test3color = io.imread('images/test3.png')
#test3 = color.rgb2gray(test3color)
#height, width = test3.shape

class BBox:
    # static var - can be accessed by BBox.bboxes - clear this before use again
    bboxes = dict()     # todo: rename

    minX = 9999
    minY = 9999

    maxX = 0
    maxY = 0

    def add(self, x, y):
        BBox.bboxes[(x,y)] = self
        if self.minX > x:
            self.minX = x
        if self.maxX < x:
            self.maxX = x
        if self.minY > y:
            self.minY = y
        if self.maxY < y:
            self.maxY = y

    def join(self, other_bbox):
        for k,v in BBox.bboxes.items():
            if v == other_bbox:
                self.add(k[0], k[1])

    def get_size(self):
        width = self.maxX - self.minX
        height = self.maxY - self.minY
        return width * height

    @staticmethod
    def add_create_bbox(x, y):
        if (x-1,y) in BBox.bboxes and not (x,y-1) in BBox.bboxes:
            # add
            BBox.bboxes[(x-1,y)].add(x,y)
        elif (x,y-1) in BBox.bboxes and not (x-1,y) in BBox.bboxes:
            # add
            BBox.bboxes[(x,y-1)].add(x,y)
```

```
            elif (x,y-1) in BBox.bboxes and (x-1,y) in BBox.bboxes:
                # join
                BBox.bboxes[(x-1,y)].add(x,y)
                BBox.bboxes[(x-1,y)].join(BBox.bboxes[(x,y-1)])
            else:
                # create new
                box = BBox()
                BBox.bboxes[(x,y)] = box


    def compute_bounding_boxes(mask, img, draw_boxes = True):
        BBox.bboxes.clear()
        height, width = mask.shape

        # calculate bboxes
        for y in range(0,height):
            for x in range (0,width):
                if mask[y, x] == 255:  # use 1.0 for test3
                    BBox.add_create_bbox(x, y)

        # draw bboxes
        if draw_boxes:
            for box in set(BBox.bboxes.values()):
                rr, cc = polygon_perimeter([box.minY, box.maxY, box.maxY, box.maxY, box.ma
                                            [box.minX, box.minX, box.minX, box.maxX, box.maxX,
                                            img.shape)
                img[rr, cc] = [255,255,255] # use [0,0,255,255] for test 3

        return set(BBox.bboxes.values())


    bboxes = compute_bounding_boxes(mask, image)
    print(len(bboxes))

    plt.figure(1, figsize=(15, 20))
    plt.imshow(mask)
    plt.figure(2, figsize=(15, 20))
    plt.imshow(image)
    plt.show()
```

2



1.2.1 Number of component

```
In [5]: from skimage import measure
        import numpy as np
```

```
print(len(bboxes))
```

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```

1.2.2 Bounding Box

```
In [6]: from skimage.measure import regionprops

        import math
        import cv2

        # draw bboxes
        for box in set(BBox.bboxes.values()):
            rr, cc = polygon_perimeter([box.minY, box.maxY, box.maxY, box.maxY, box.maxY, box.
                                       [box.minX, box.minX, box.minX, box.maxX, box.maxX, box.maxX
                                       image.shape)

            image[rr, cc] = [255,255,0] # use [0,0,255,255] for test 3

        plt.figure(figsize=(15, 20))
        plt.imshow(image)
        plt.show()
```

1.3 Exercise 1.3

- use your color detection and connected components algorithm

- implement simplest tracking algorithm
- draw history of all previous points on frame (**RESULT**)

```
In [8]: def get_file_name(i):
            if i < 10:
                return "images/racecar/00" + str(i) + ".jpeg"
            if i < 100:
                return "images/racecar/0" + str(i) + ".jpeg"
            return "images/racecar/" + str(i) + ".jpeg"

        def draw_line(img, coord_list):
            coords = list(map(list, zip(*coord_list)))
            rr, cc = polygon_perimeter(coords[0], coords[1], img.shape, clip=False)
            img[cc,rr] = [0,0,255] # use [0,0,255,255] for test 3
            return img

In [11]: tracking_points = []

         for i in range(0 ,150, 1):
             print(i)
             tmp_image = io.imread(get_file_name(i))
             height, width, _ = tmp_image.shape
             tmp_mask = create_mask(tmp_image, width, height)

             eroded = erosion(tmp_mask, selem)
             dilated = dilation(eroded, selem)

             tmp_box = compute_bounding_boxes(dilated, tmp_image, draw_boxes = False)
             print("Ammount of bboxes: " + str(len(tmp_box)))

             l = list(tmp_box)

             # use greatest bounding box
             largest = None
             size = 0
             for b in l:
                 if b.get_size() > size:
                     largest = b
                     size = b.get_size()

             if largest:
                 tracking_points.append( (largest.minX, largest.minY) )
                 rr, cc = polygon_perimeter([largest.minY, largest.maxY, largest.maxY, largest
                                             largest.maxY, largest.minY, largest.minY],
                                            [largest.minX, largest.minX, largest.minX, largest
                                             largest.maxX, largest.maxX, largest.minX],
                                             tmp_image.shape)
                 tmp_image[rr, cc] = [255,255,255] # use [0,0,255,255] for test 3
```

```
            if (len(tracking_points) > 2):
                tmp_image = draw_line(tmp_image, tracking_points)

            plt.figure(i, figsize=(15,20))
            plt.imshow(tmp_image)


        # plt.figure(8, figsize=(15,20))
        # tmp_image = io.imread(get_file_name(151))
        # tmp_image = draw_line(tmp_image, tracking_points)
        plt.imshow(tmp_image)

        #plt.figure(figsize=(15,20))
        plt.show()
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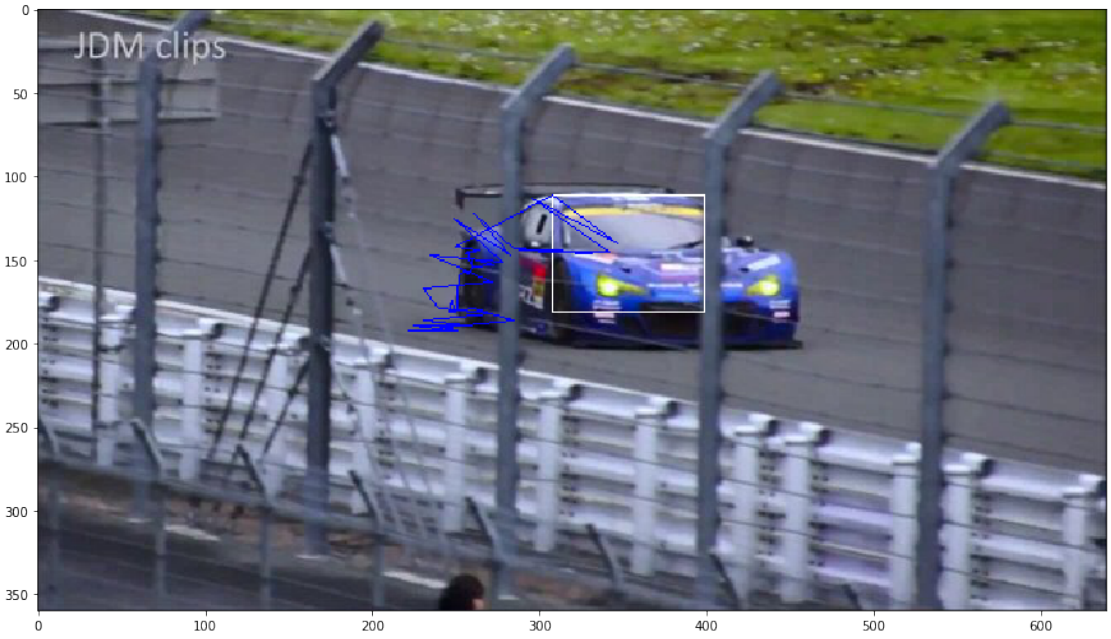
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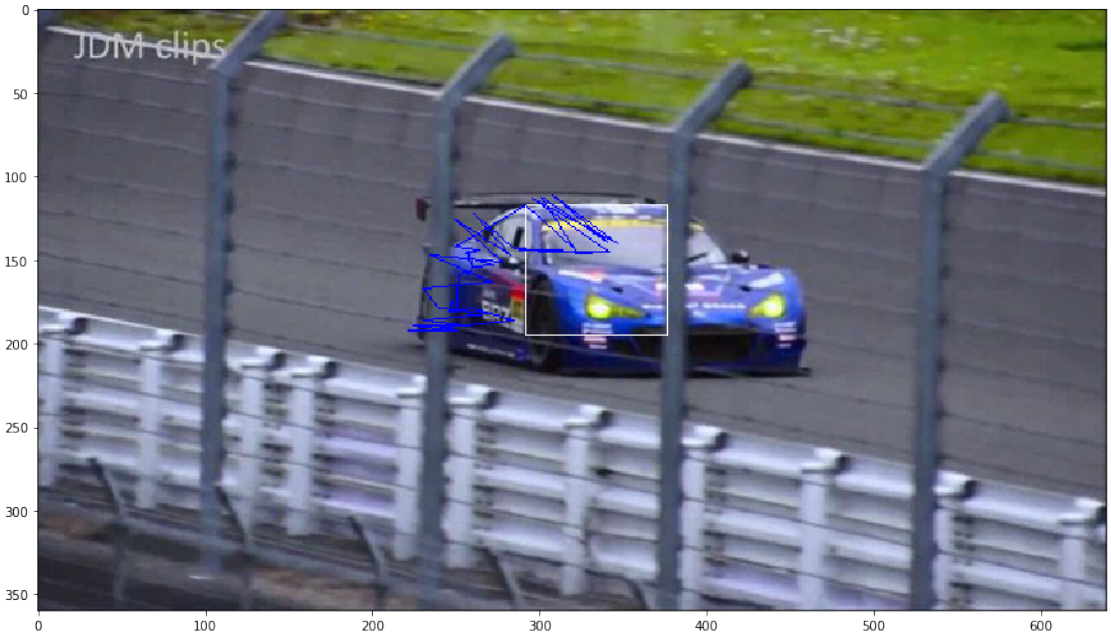
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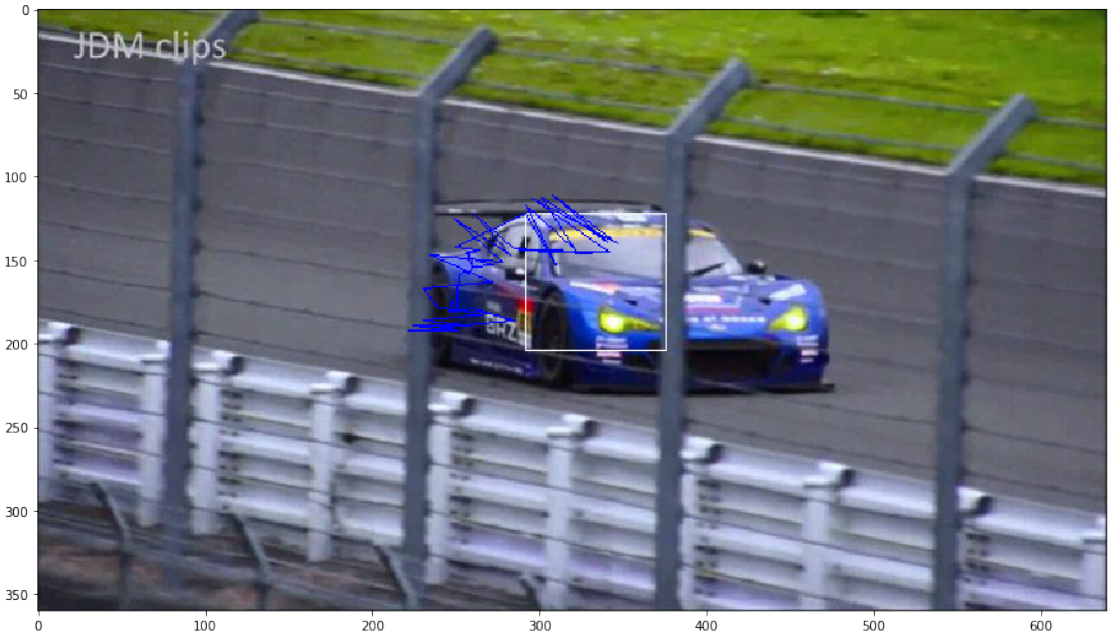
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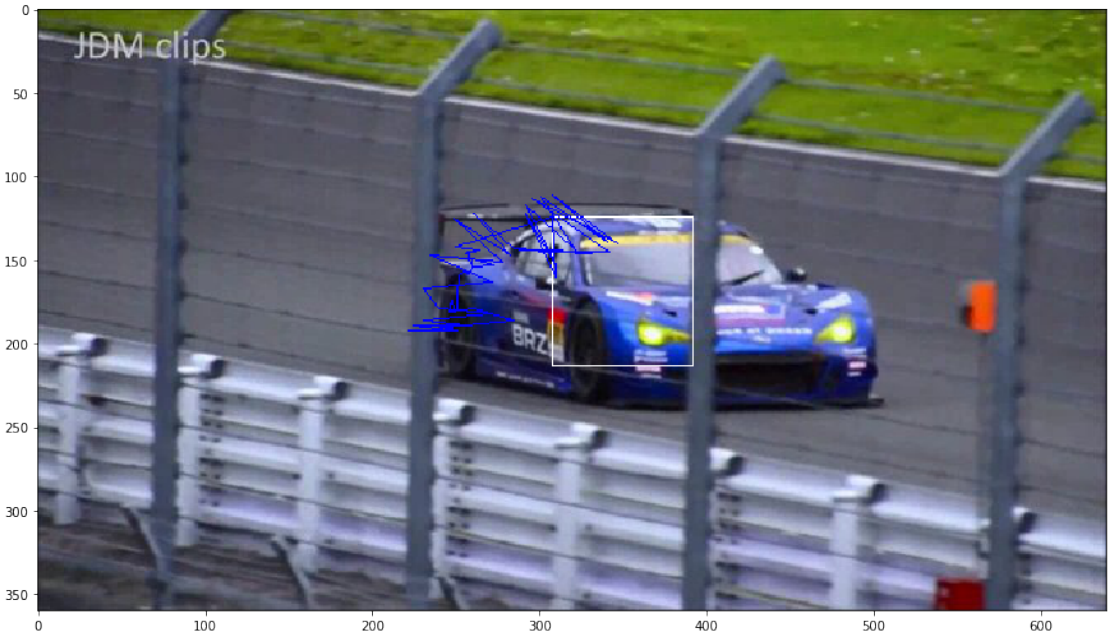
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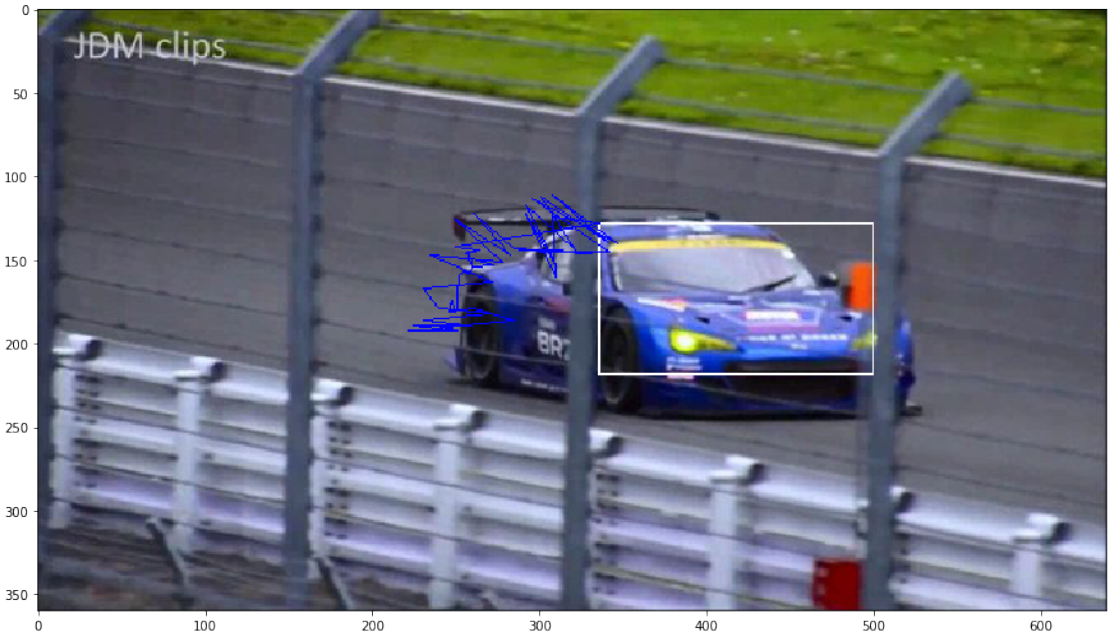
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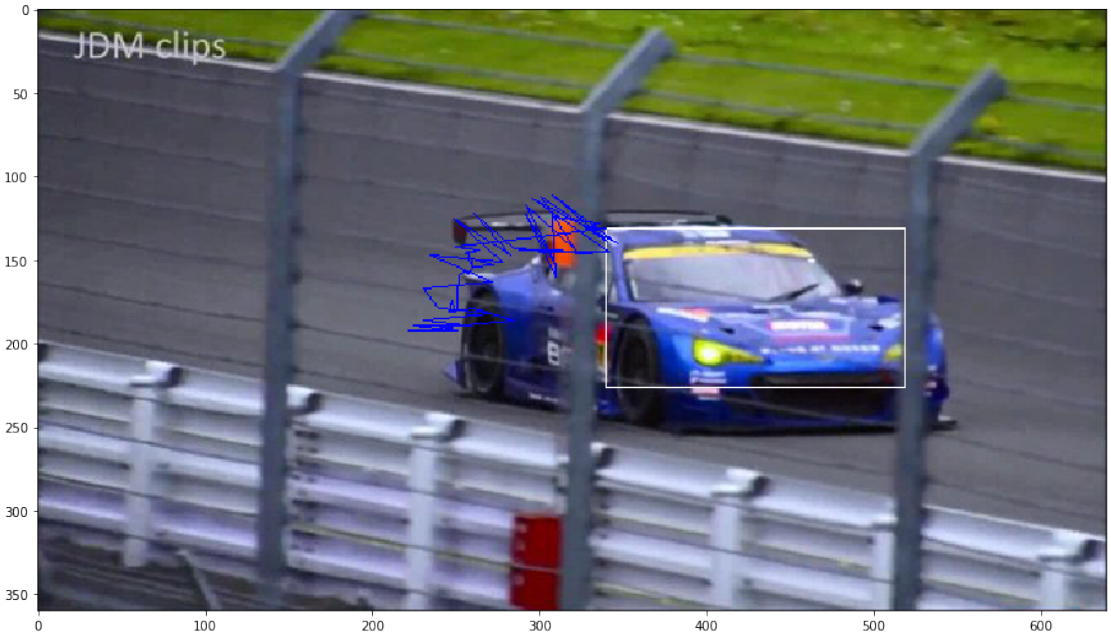
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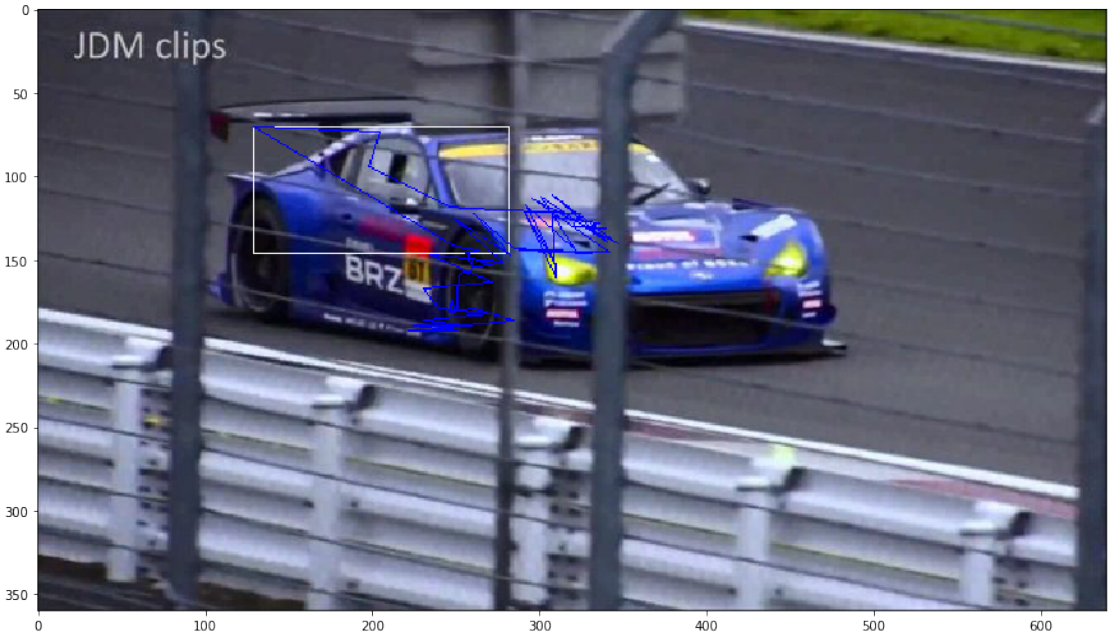
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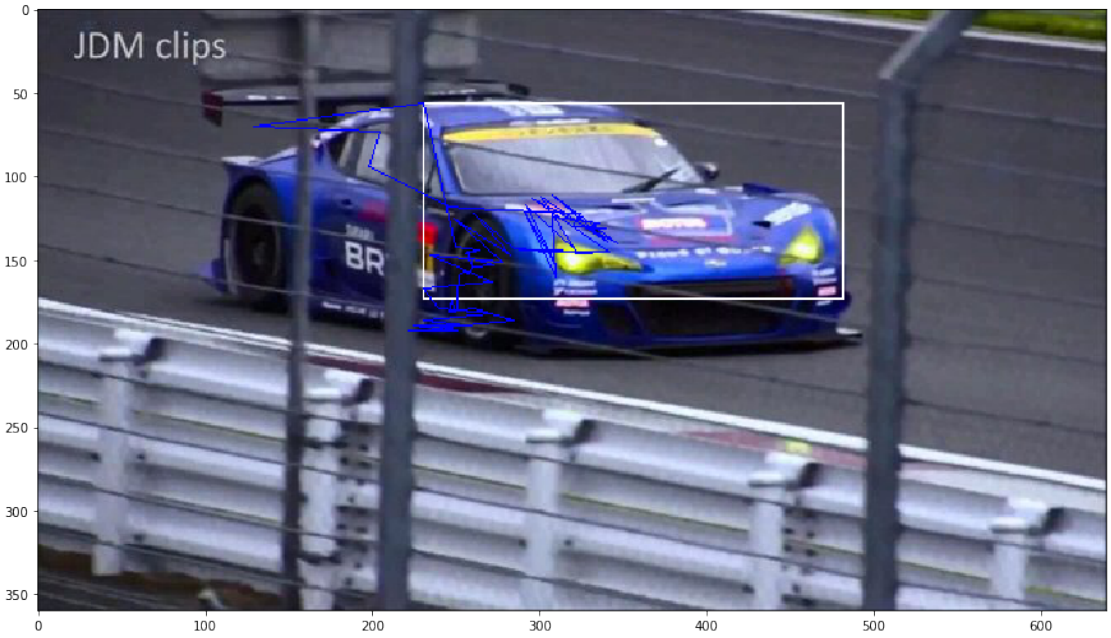
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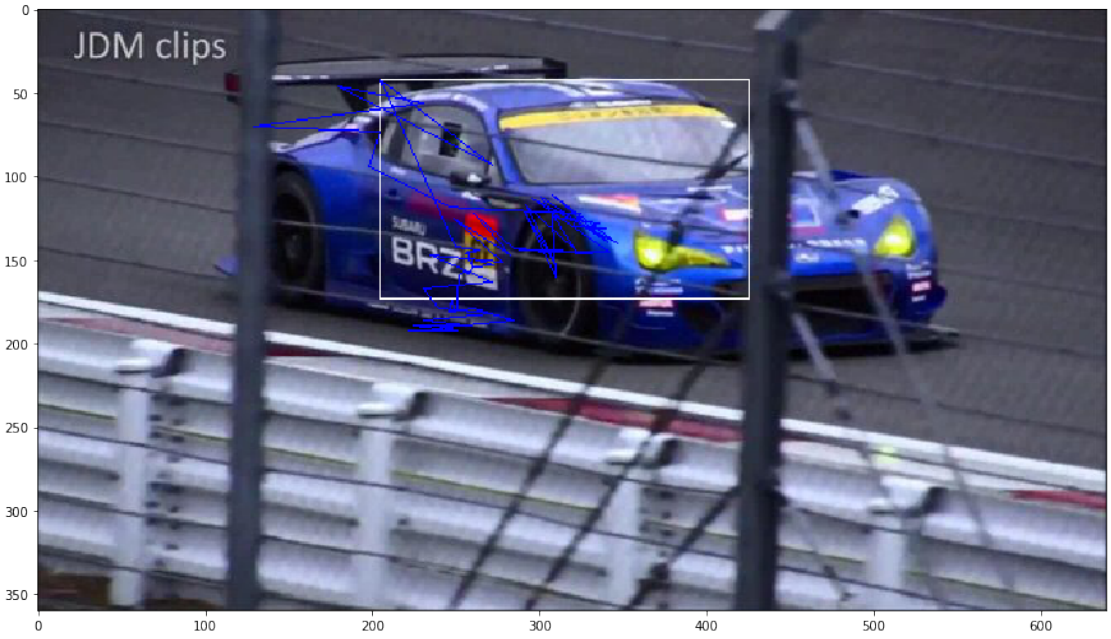
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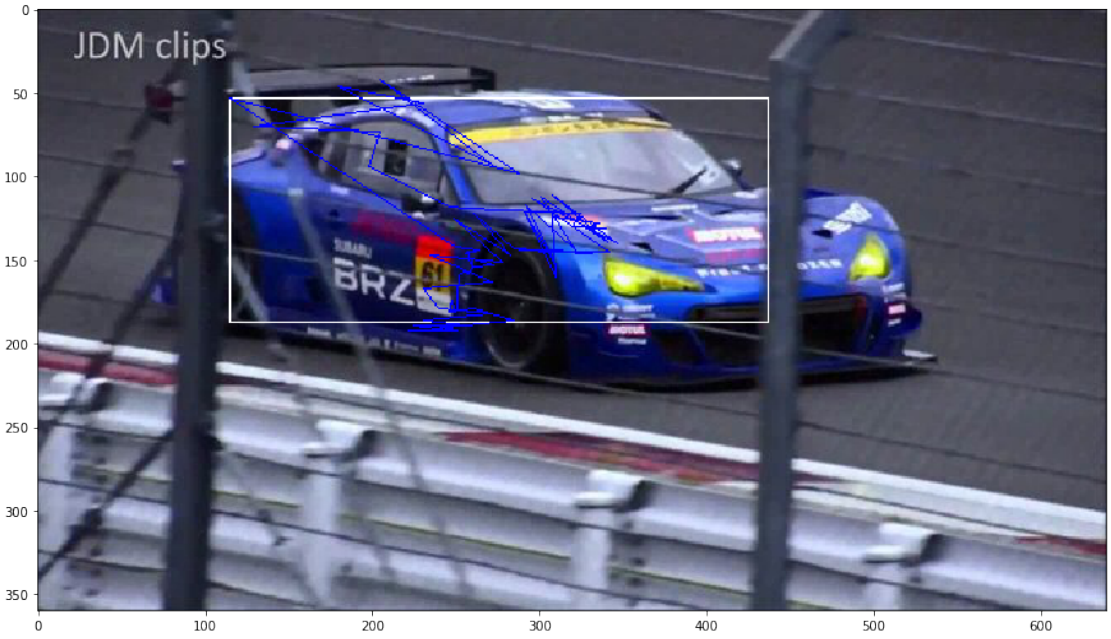
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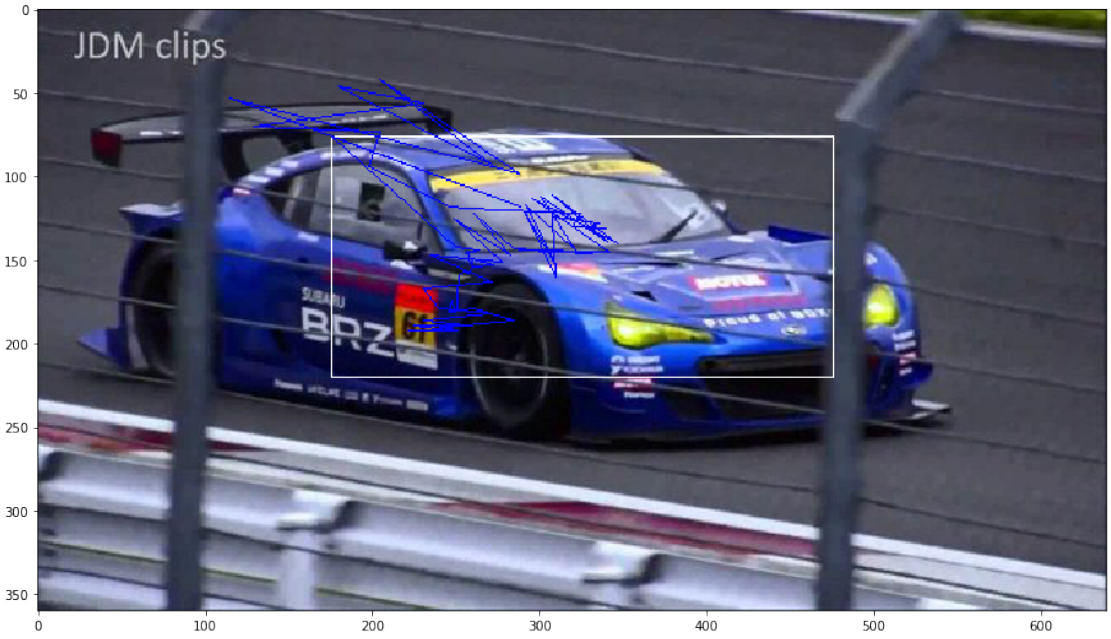
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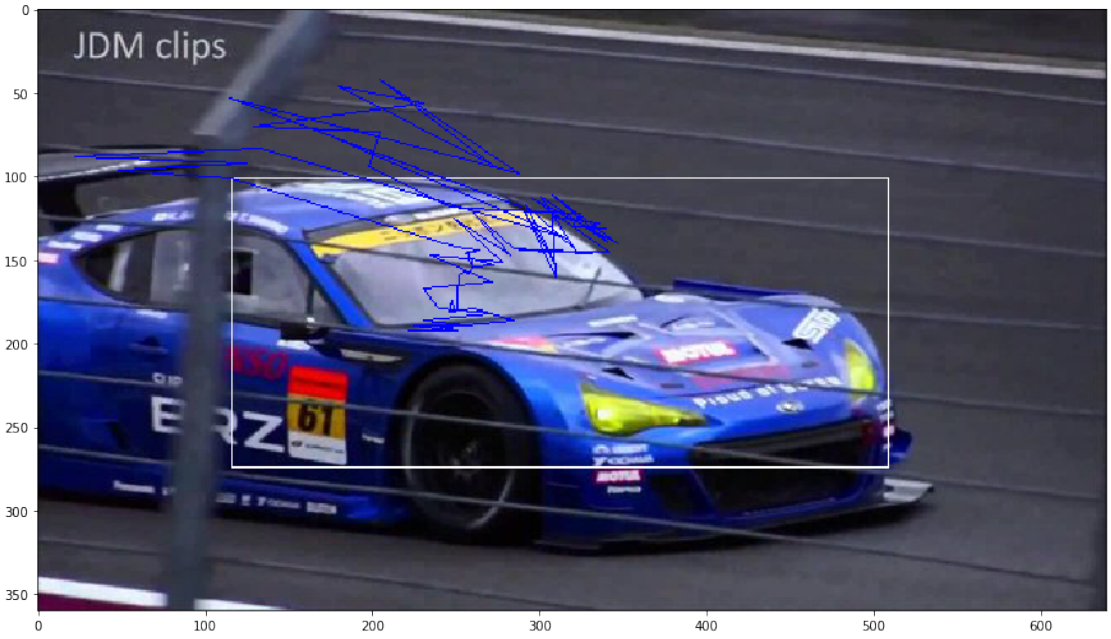
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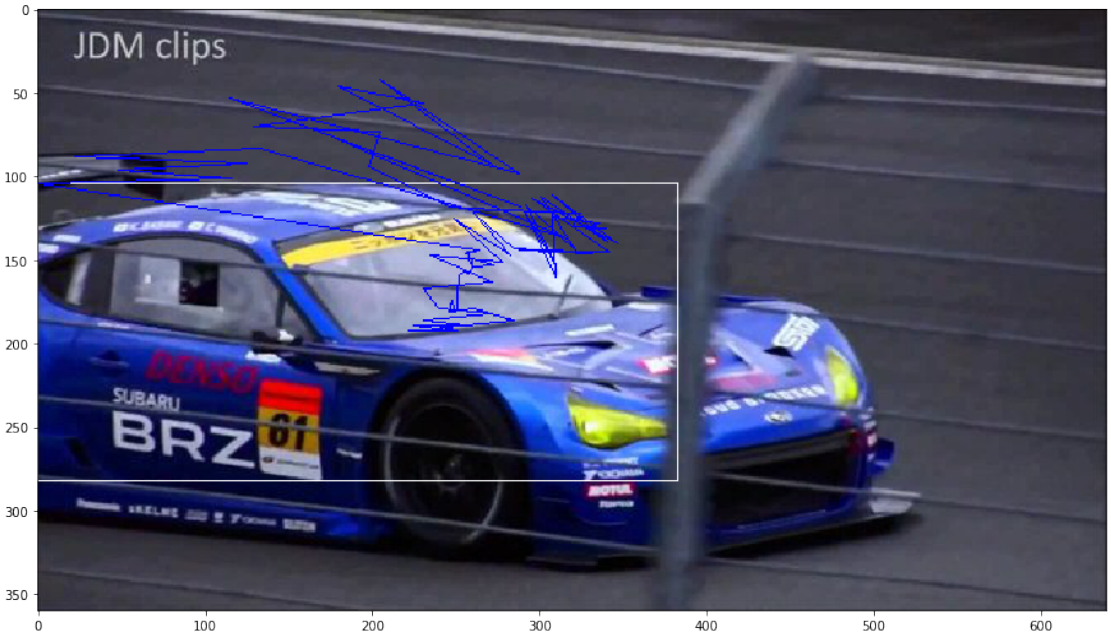
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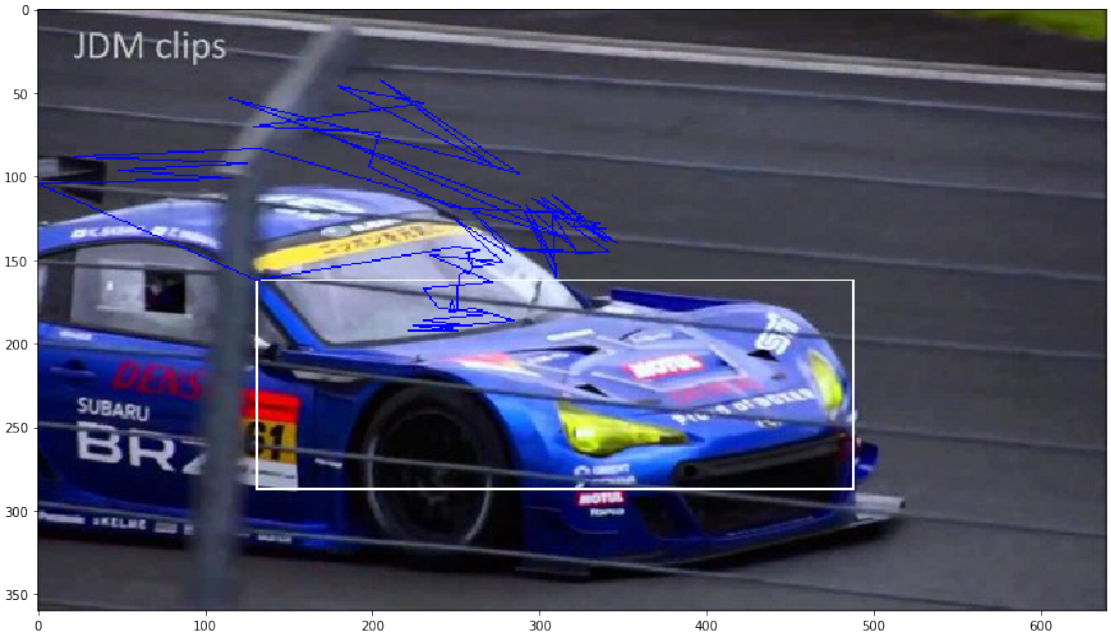
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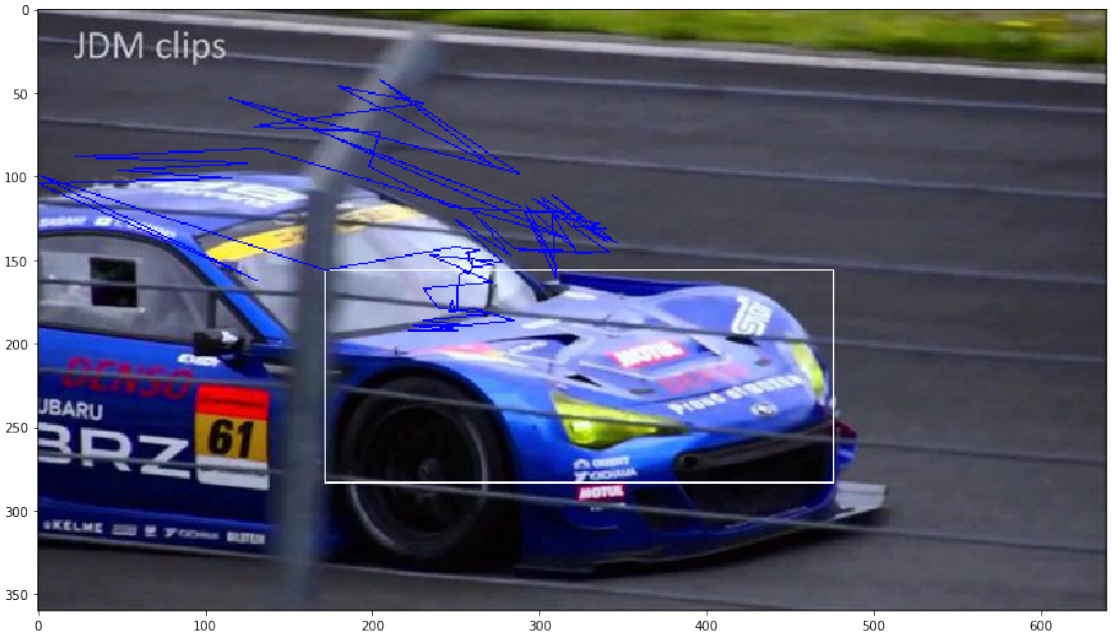
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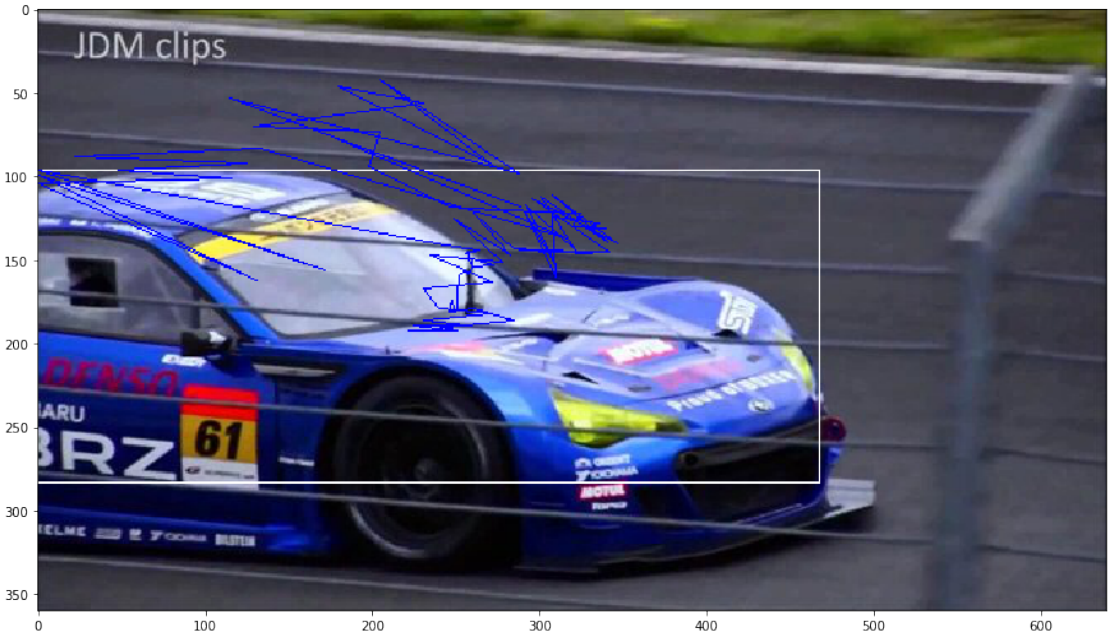
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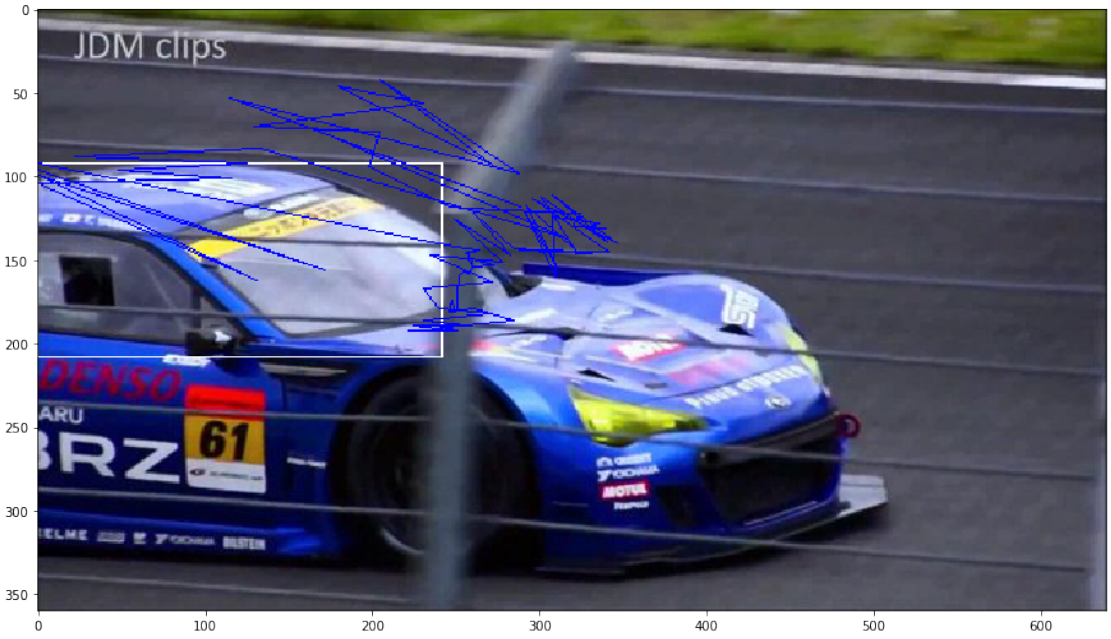
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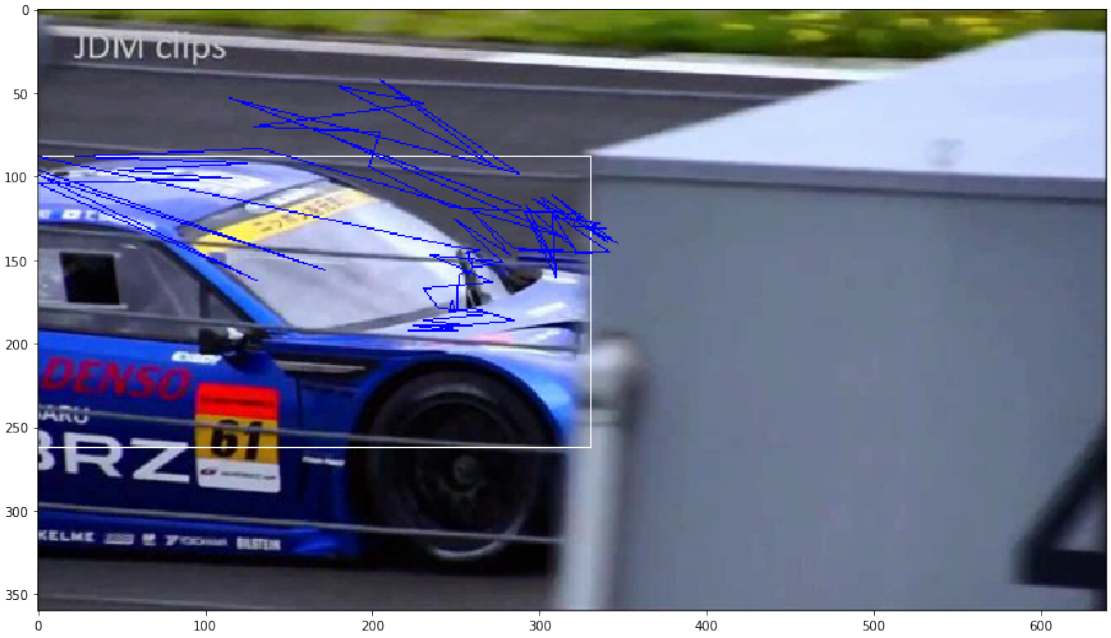
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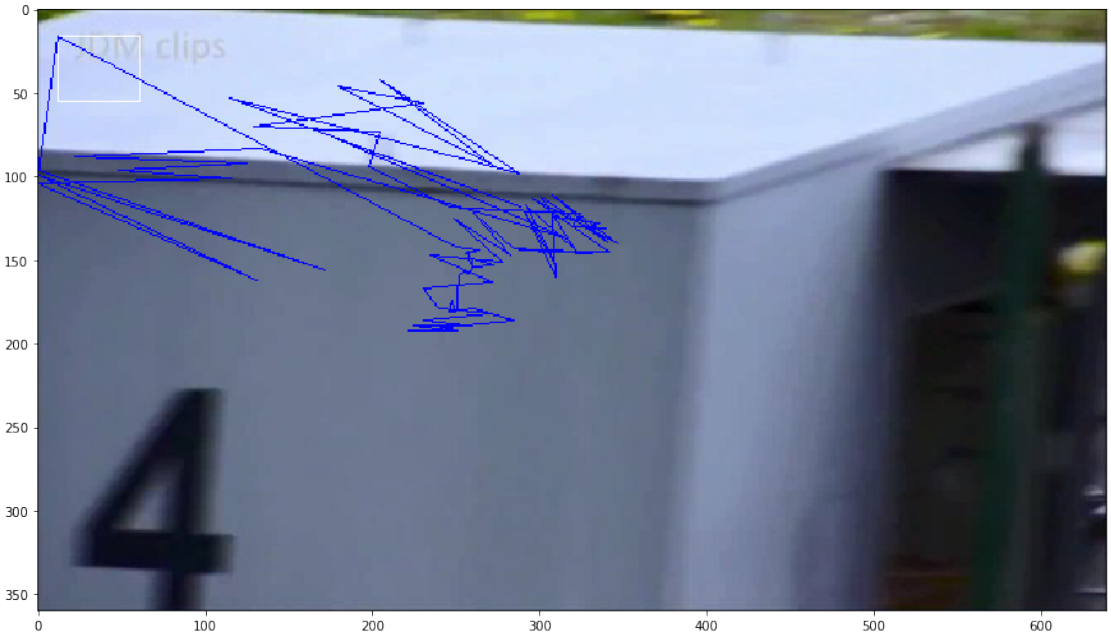
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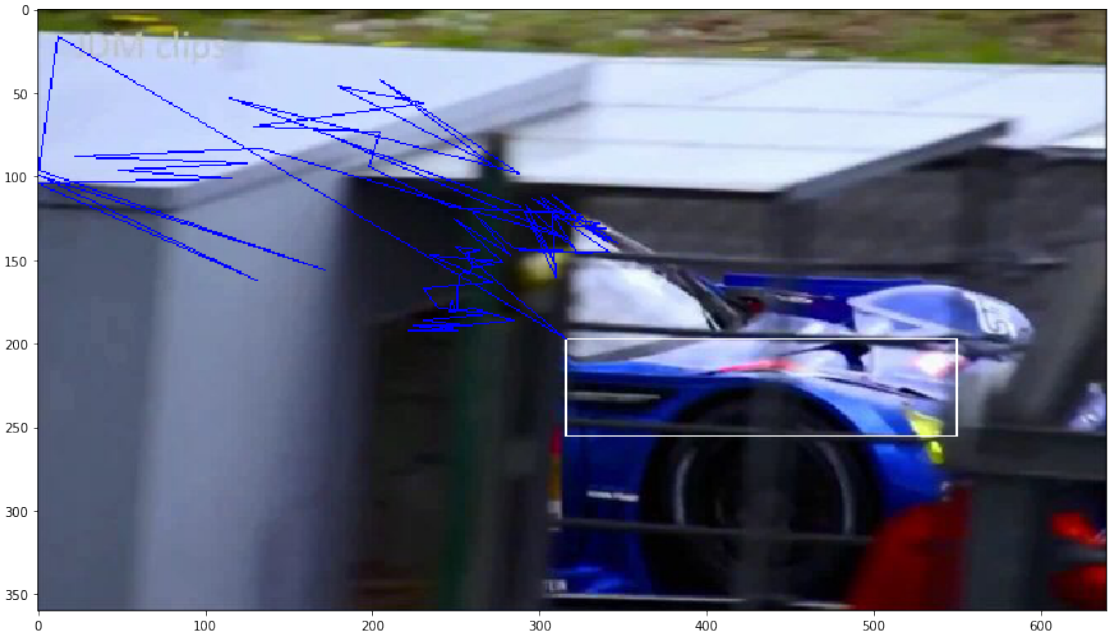
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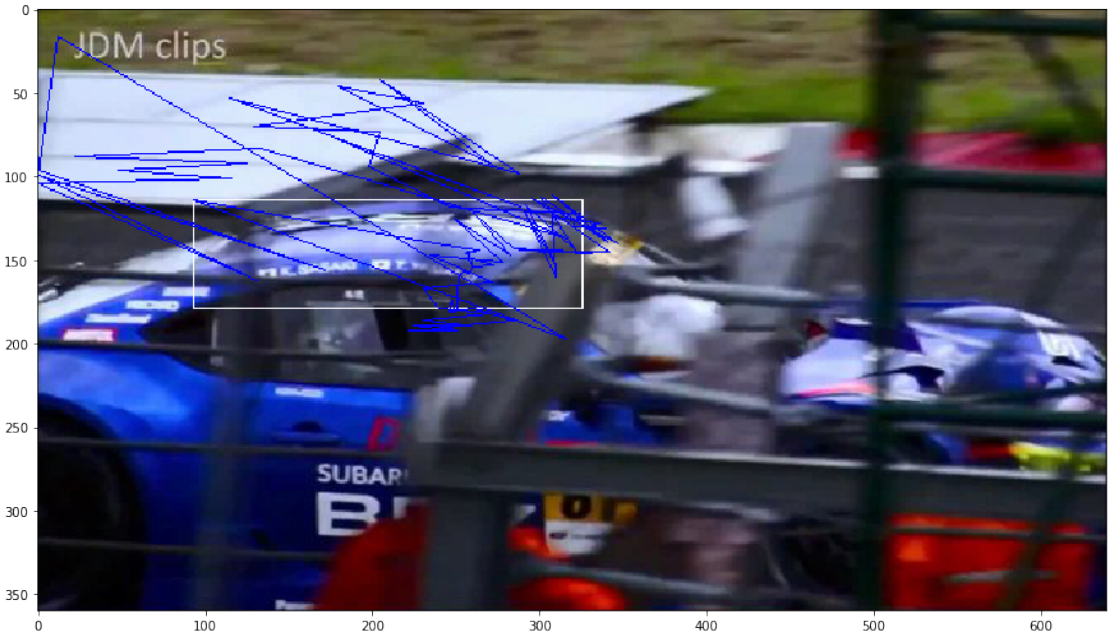
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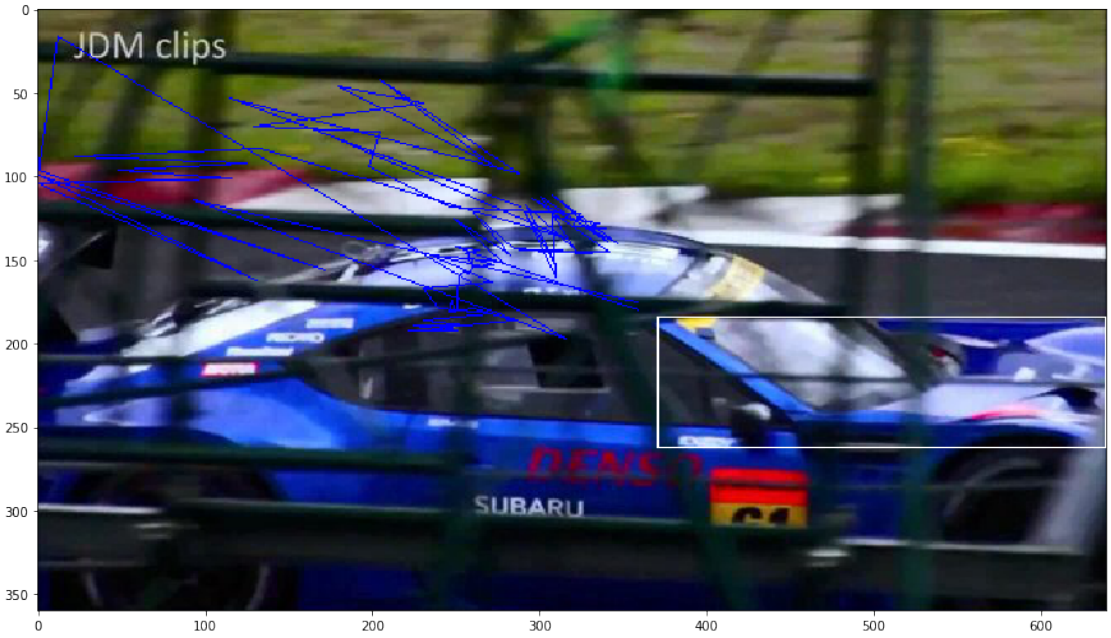
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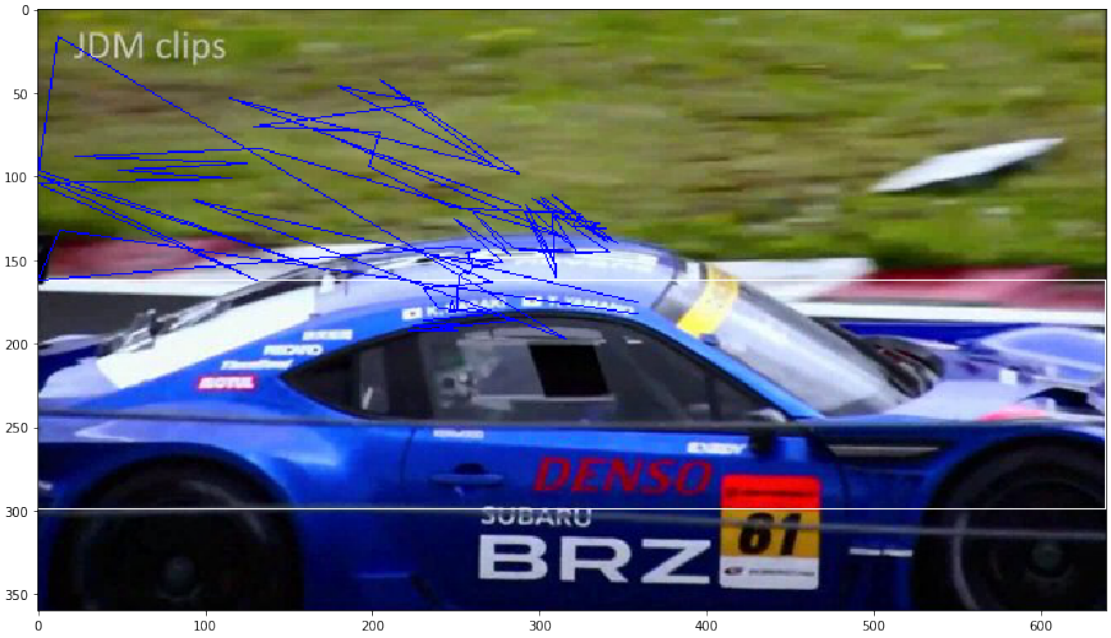
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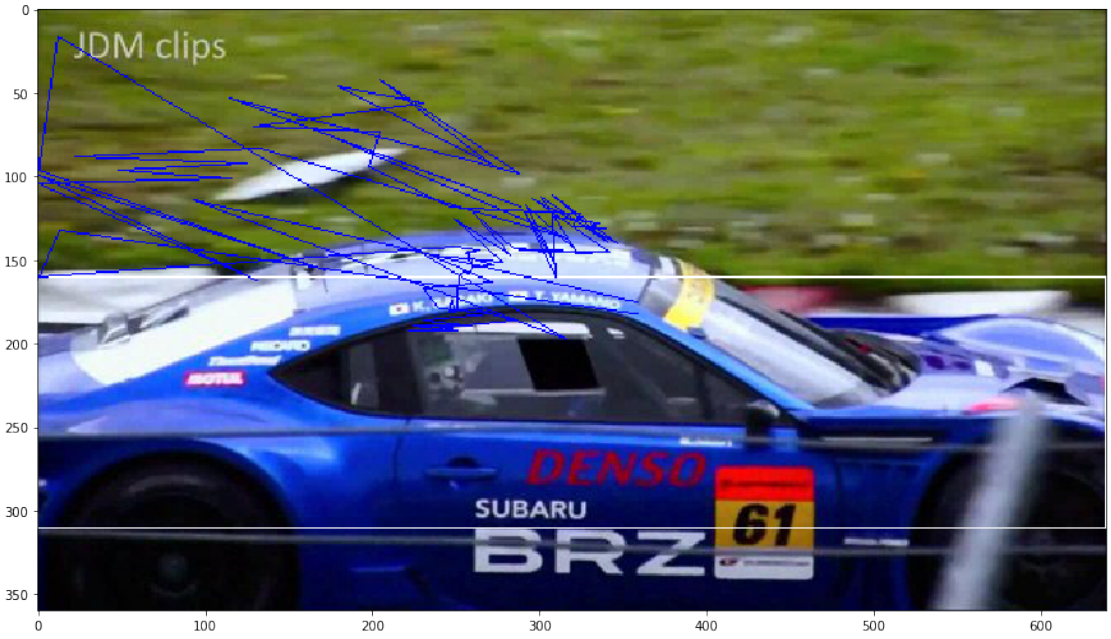
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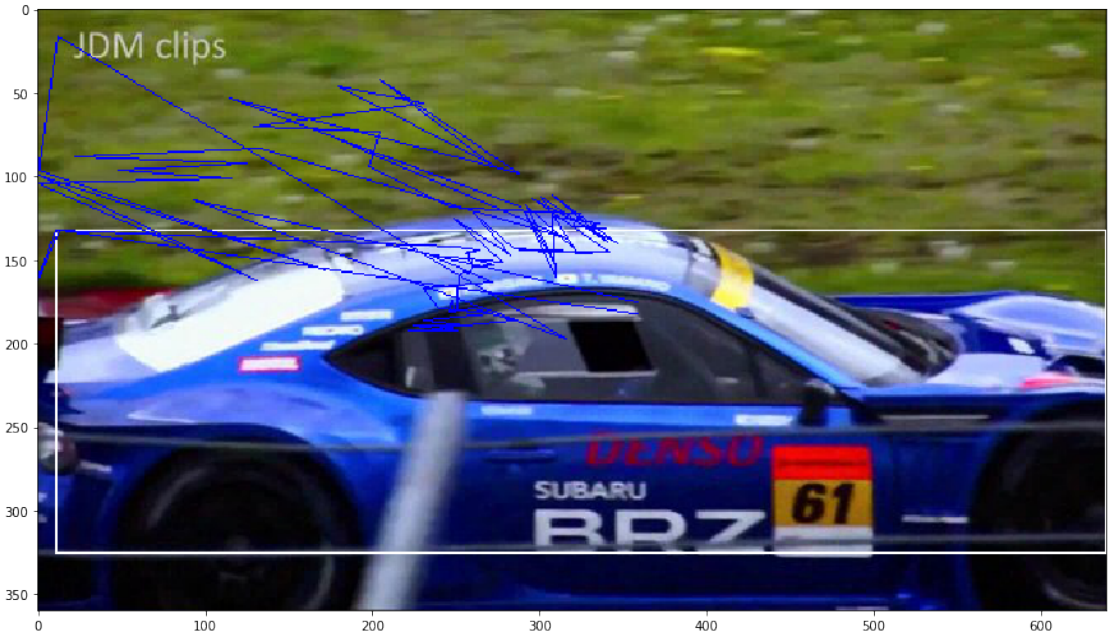
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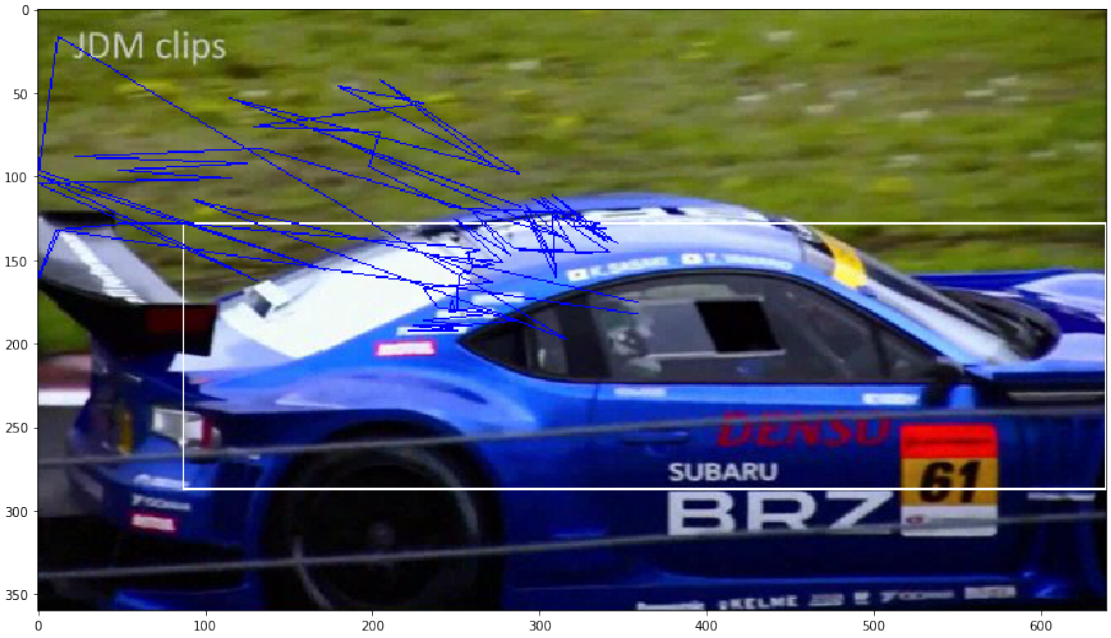
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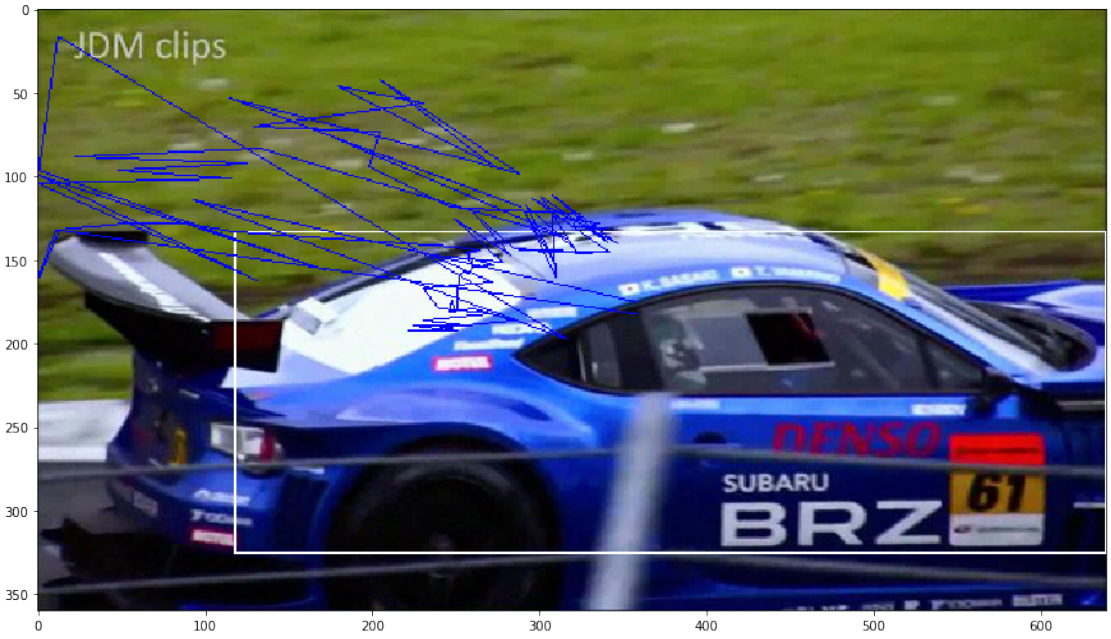
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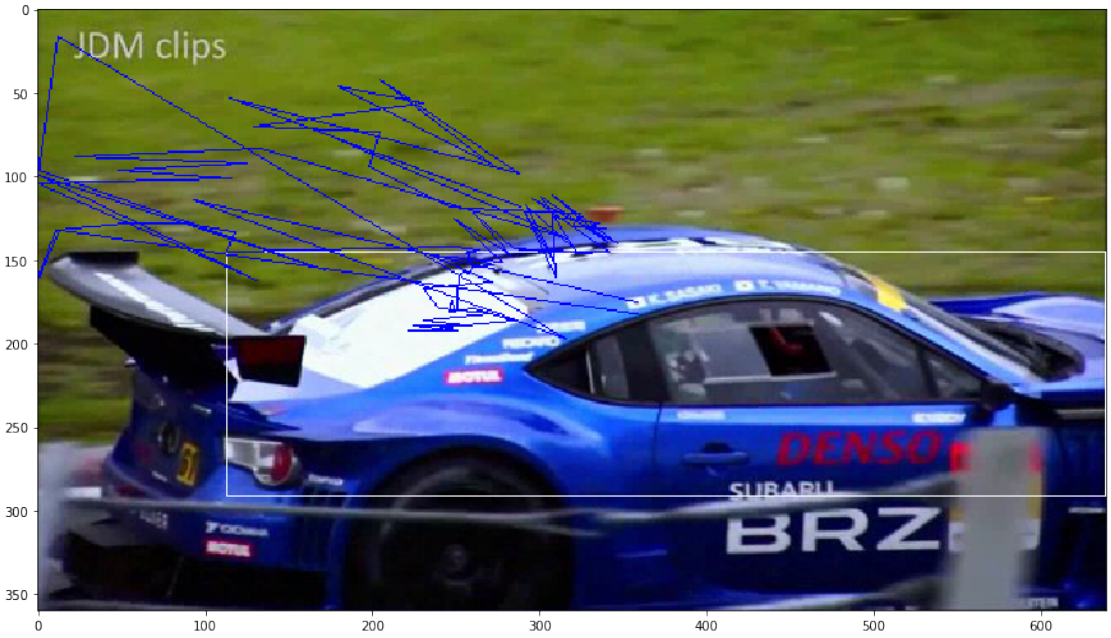
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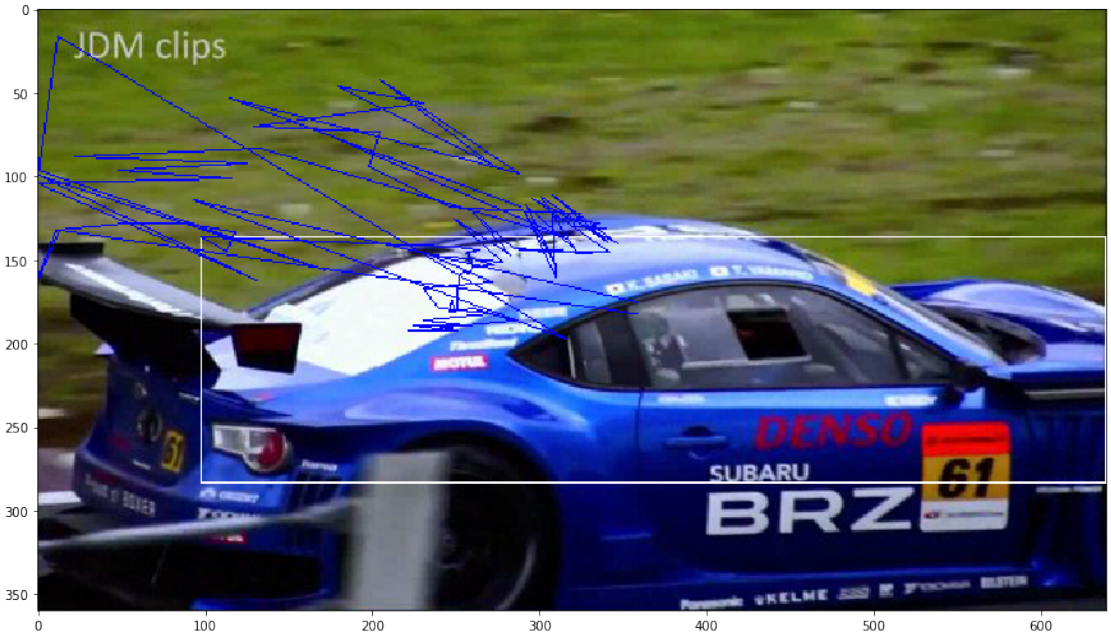
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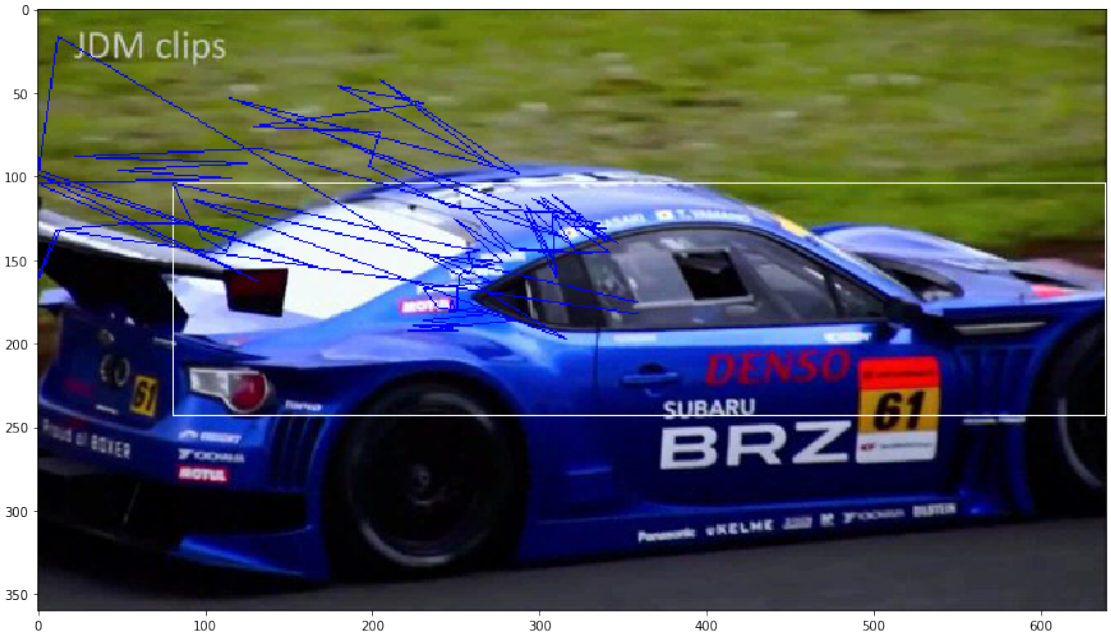
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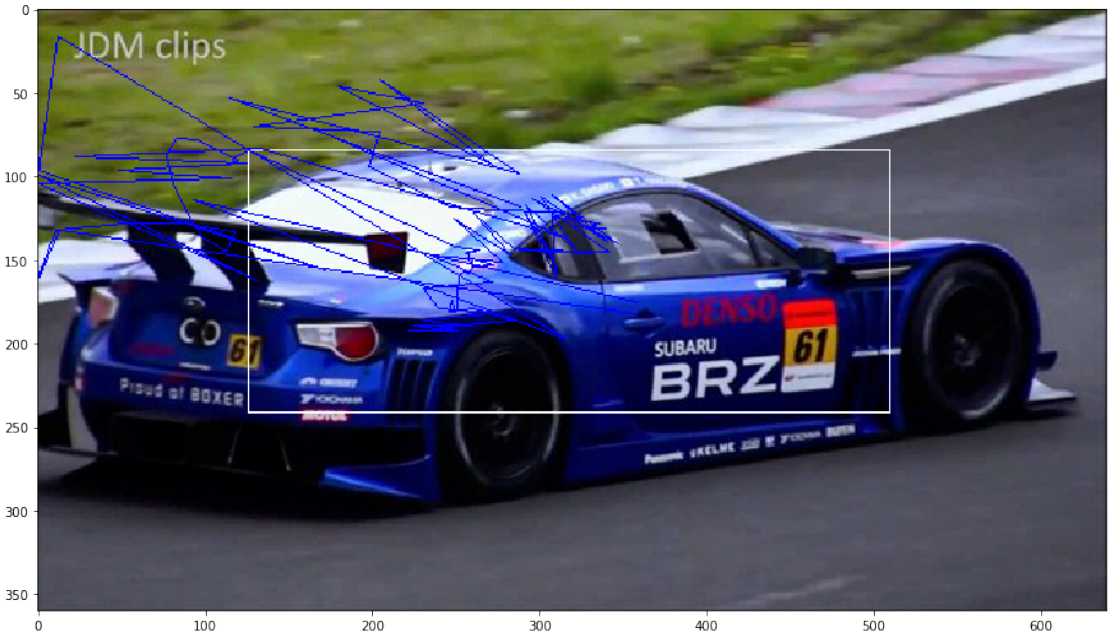
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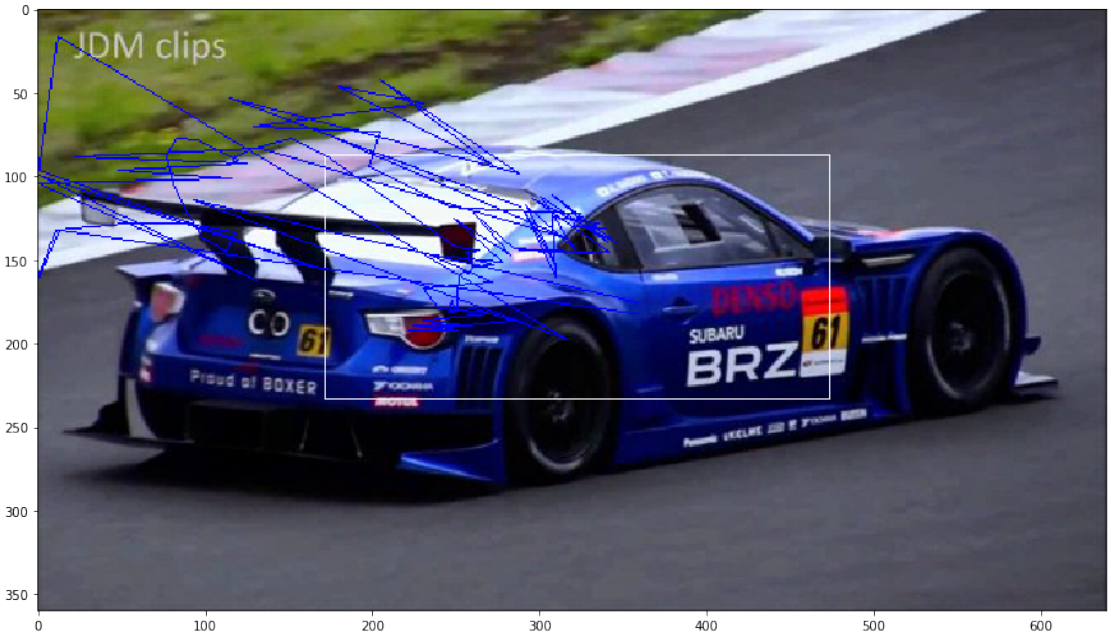
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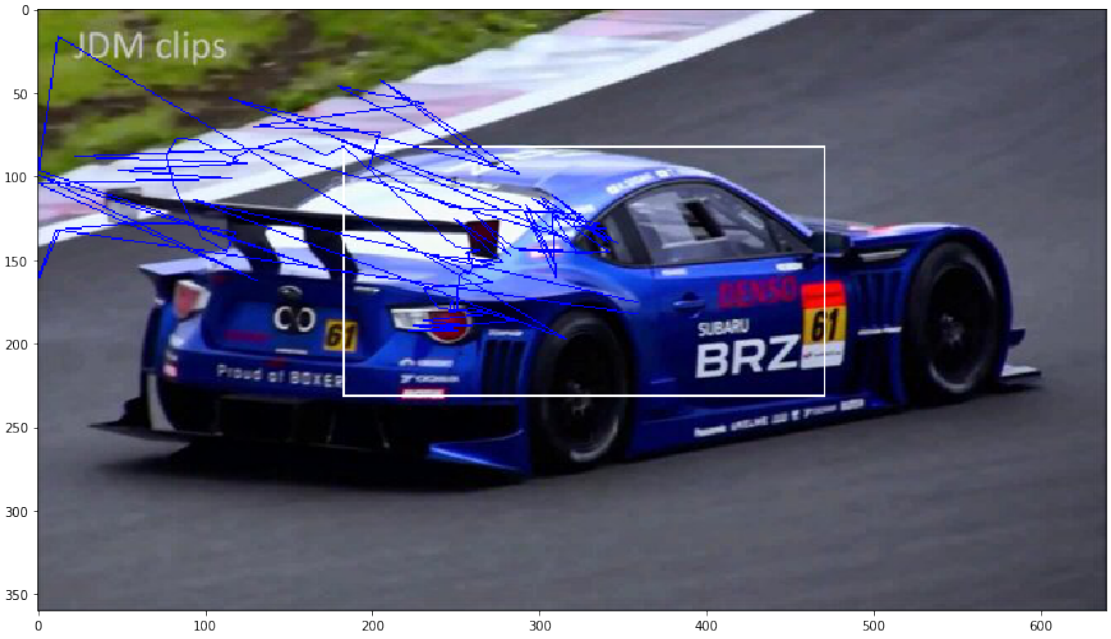
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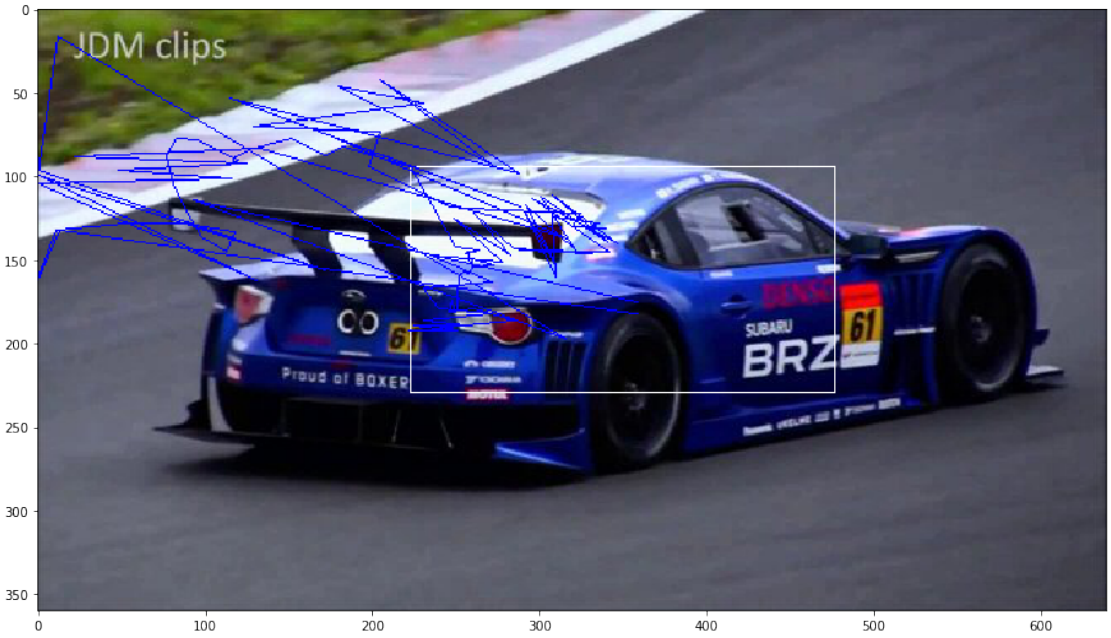
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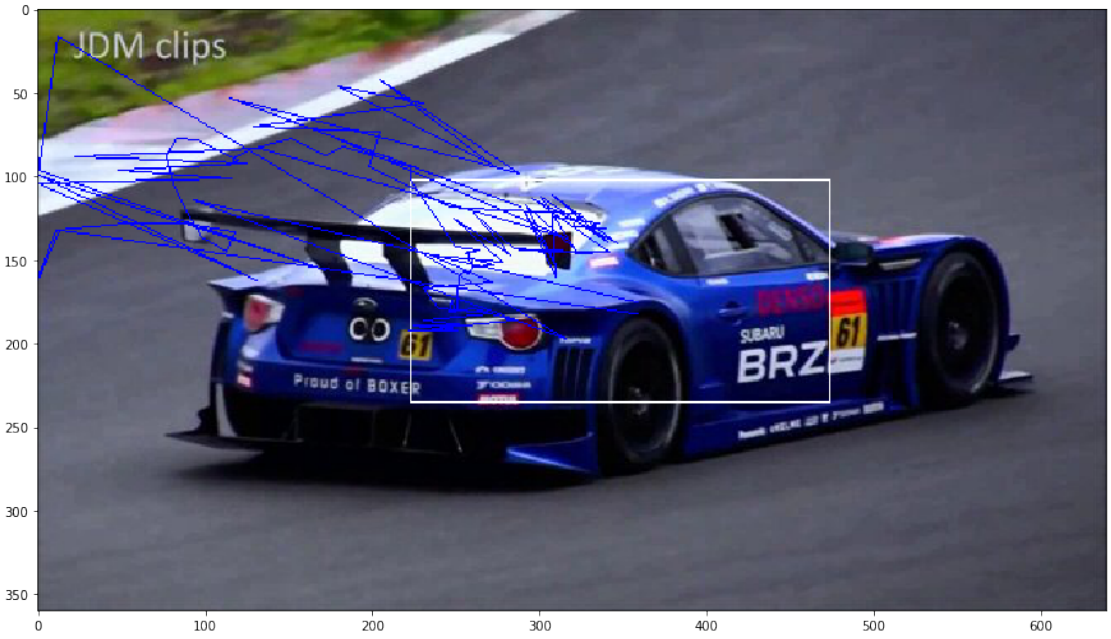
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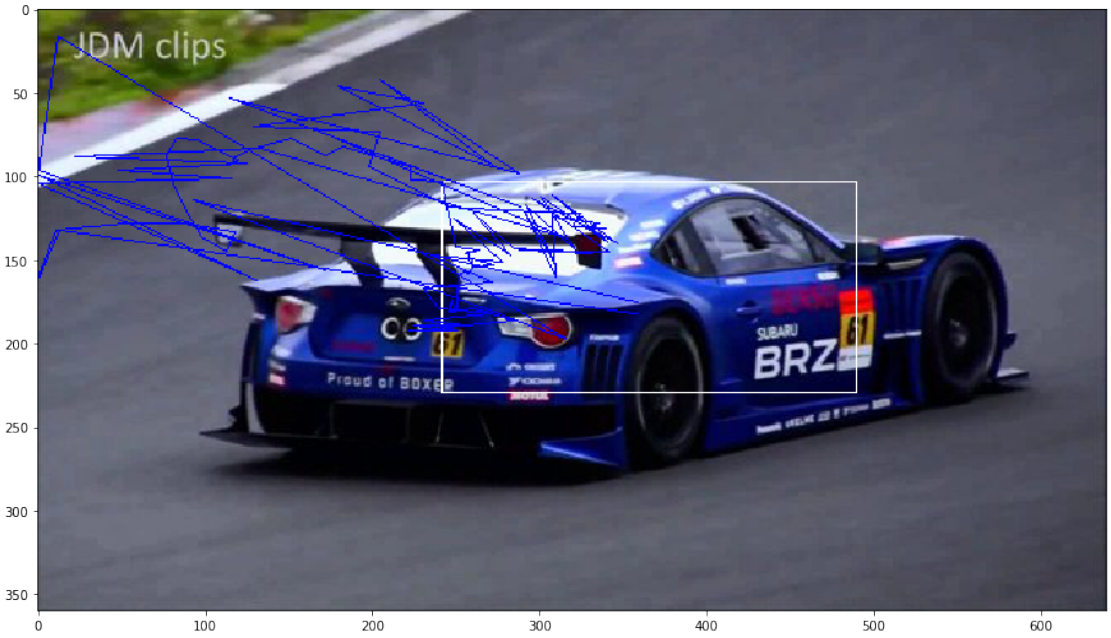
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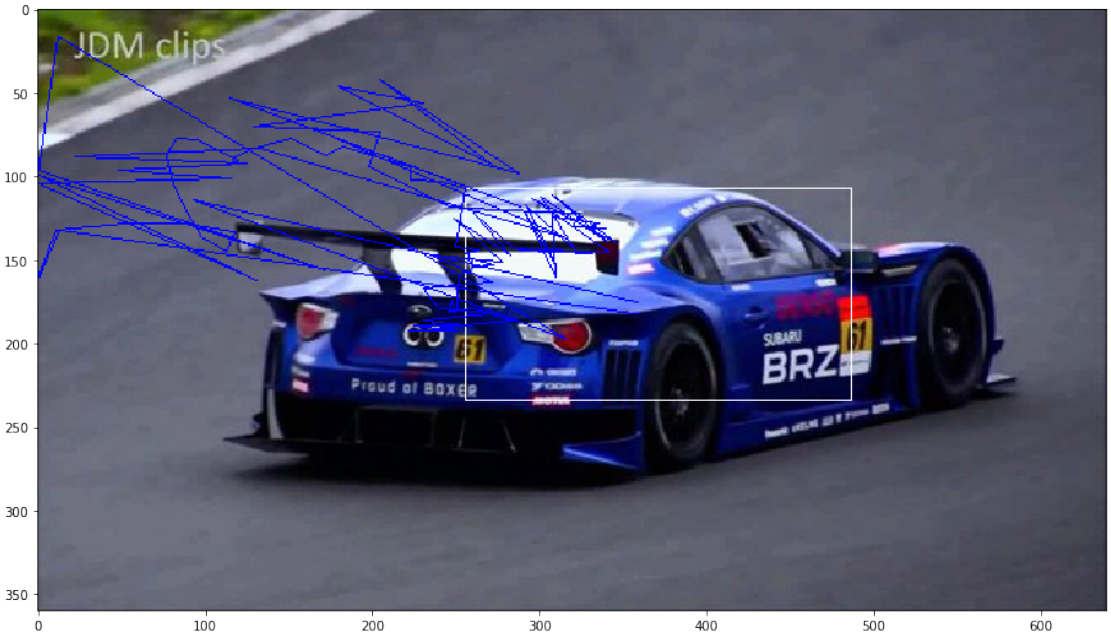
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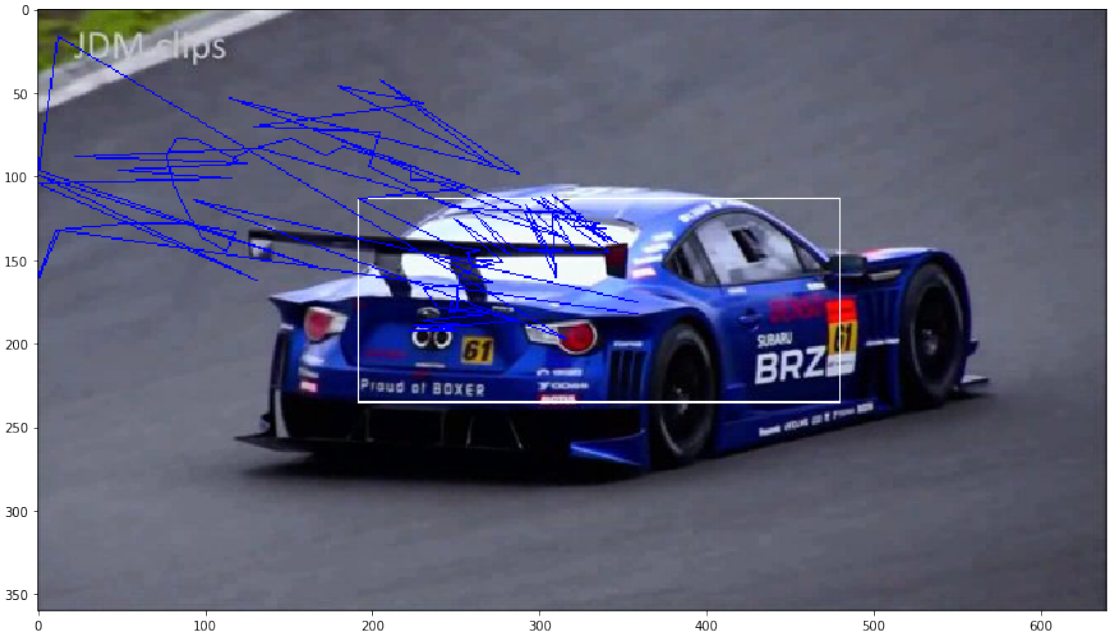
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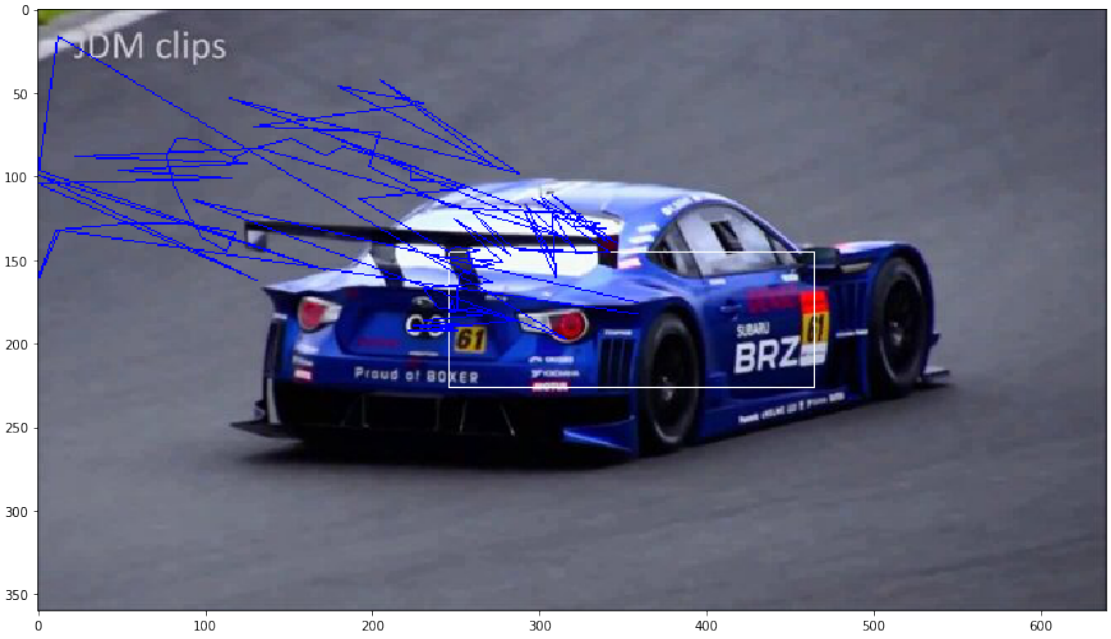
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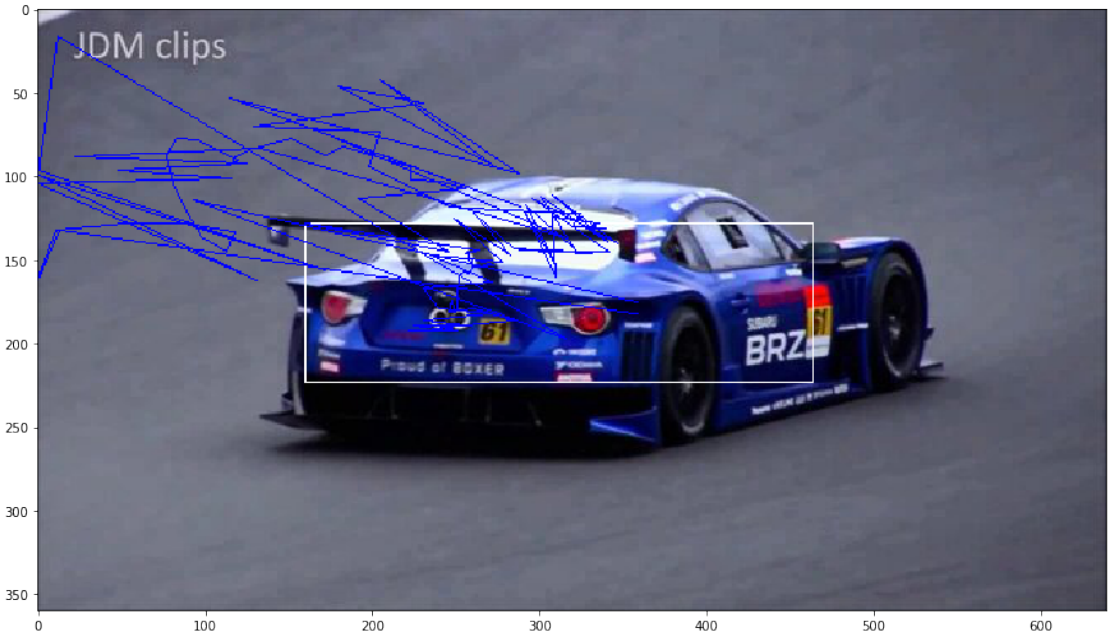
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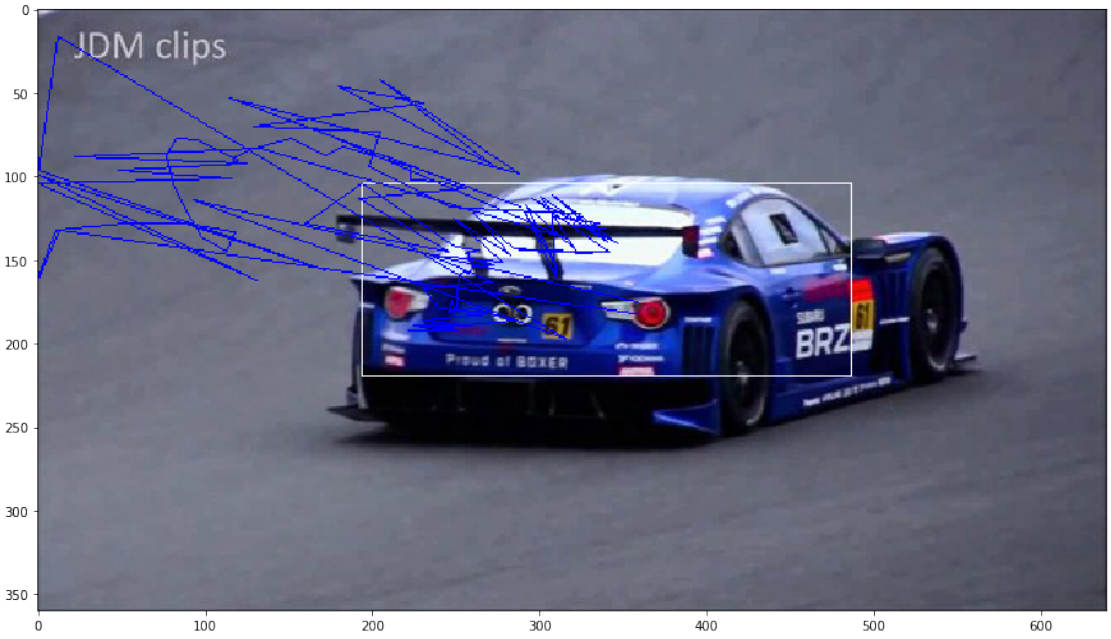
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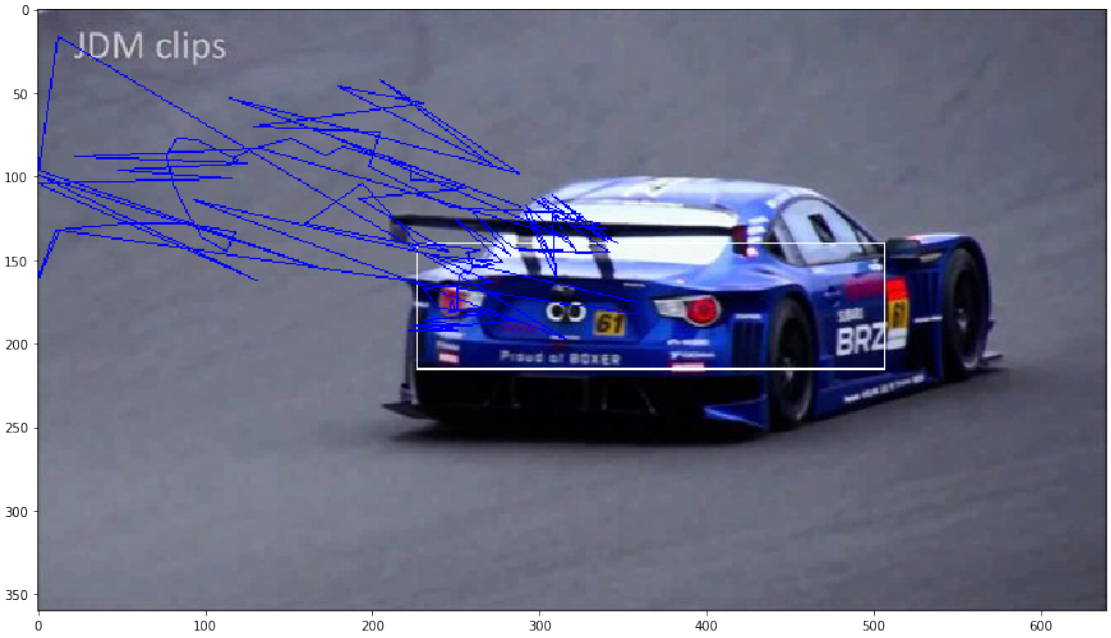
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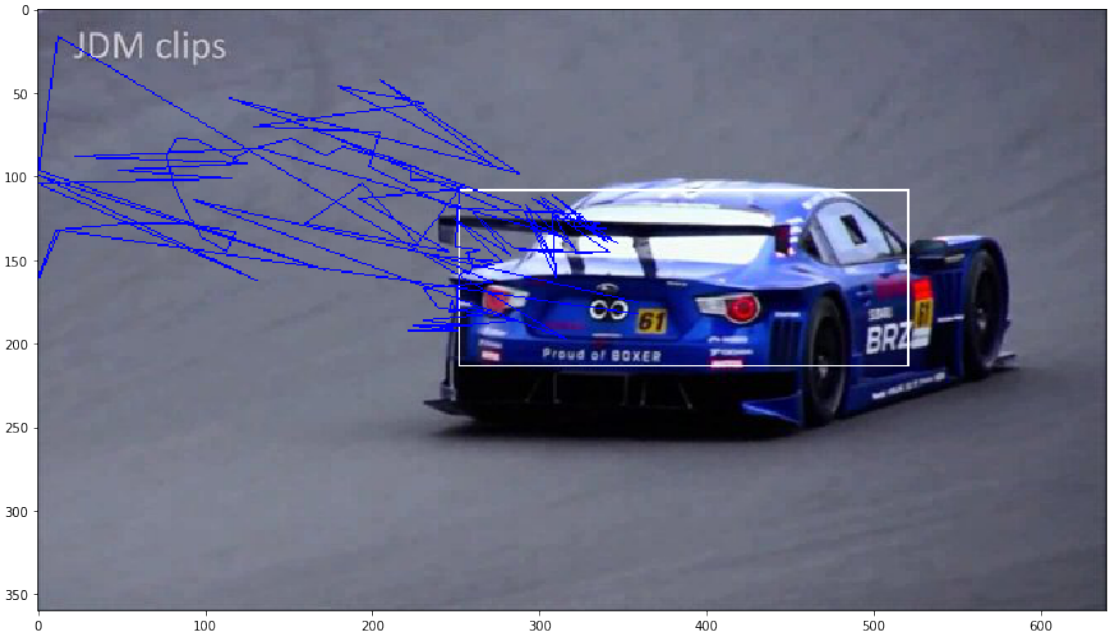
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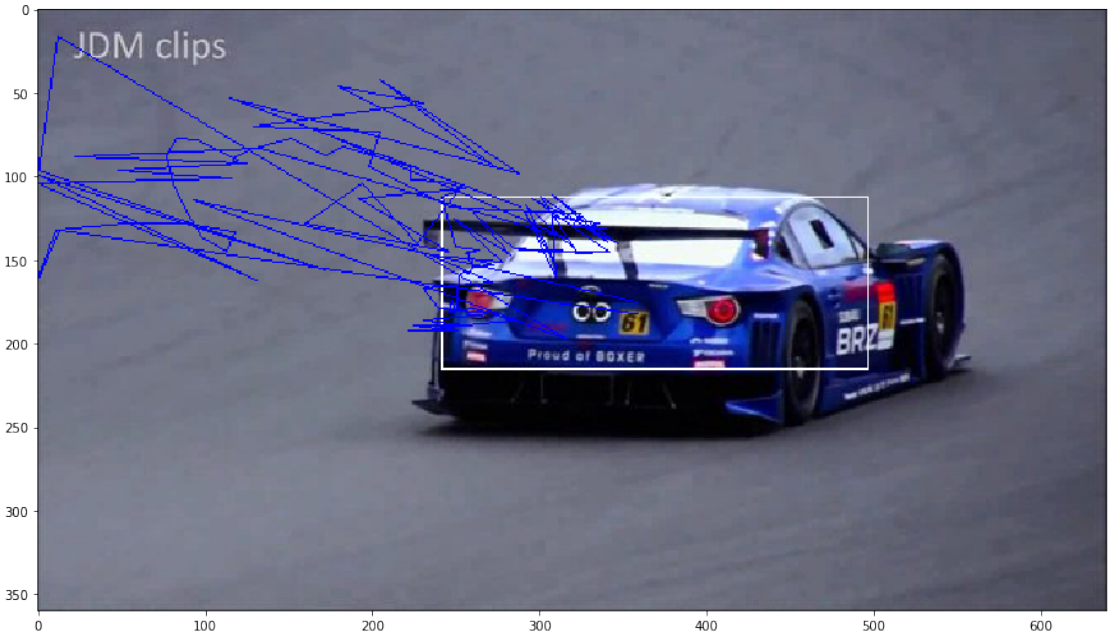
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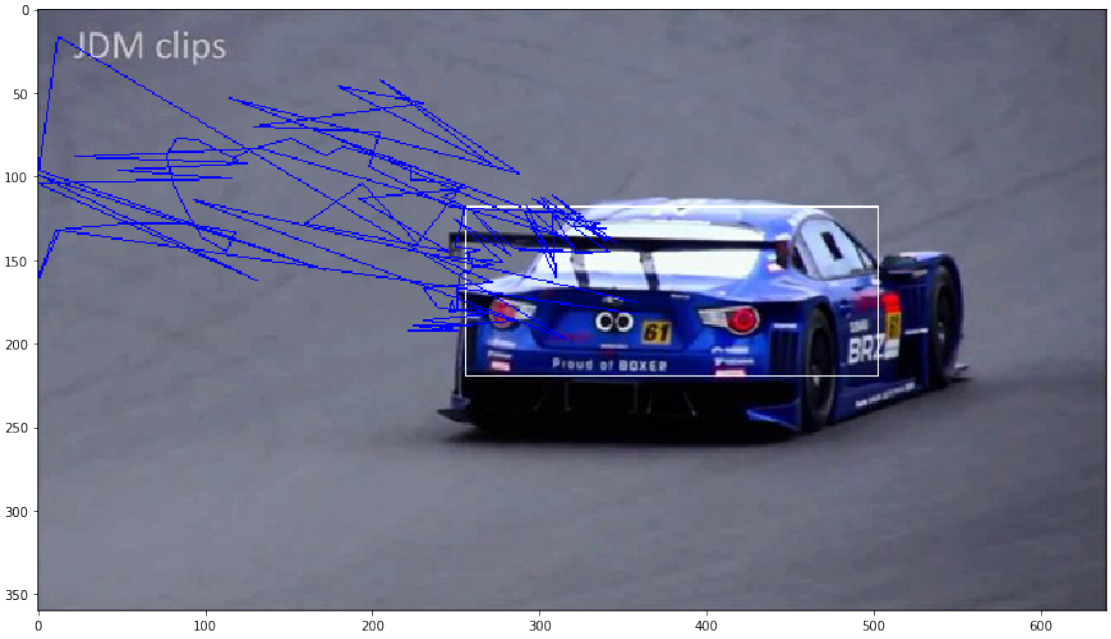
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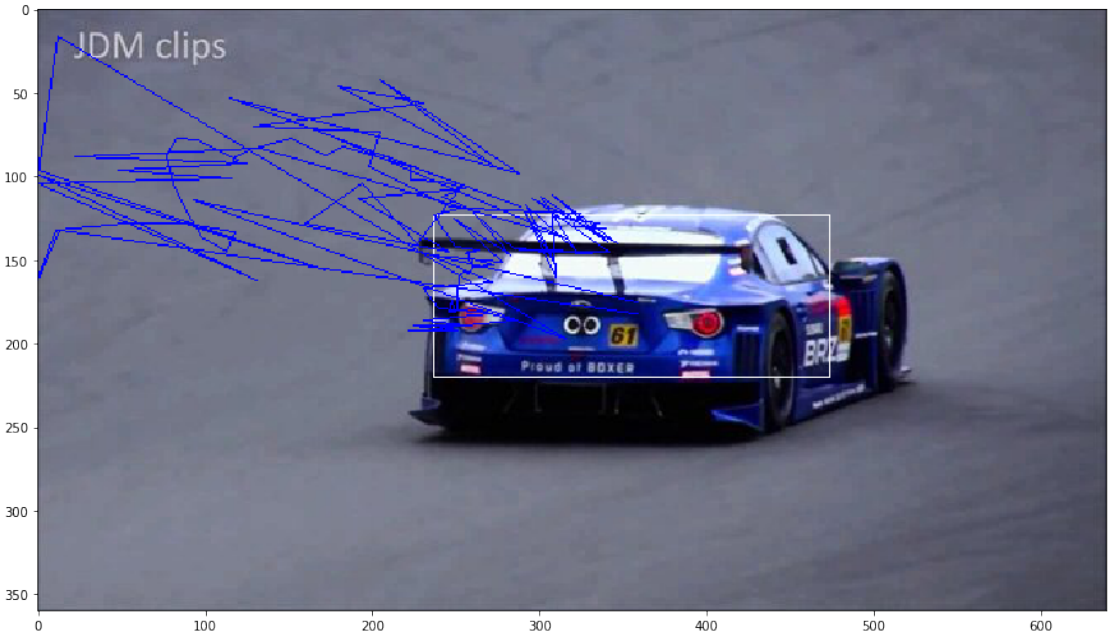
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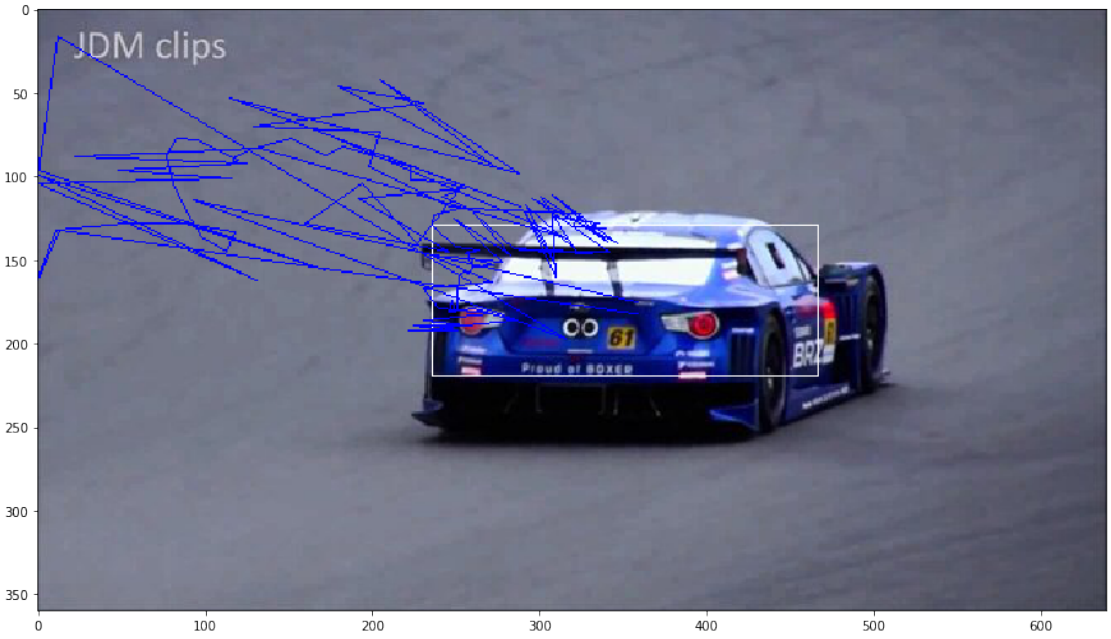
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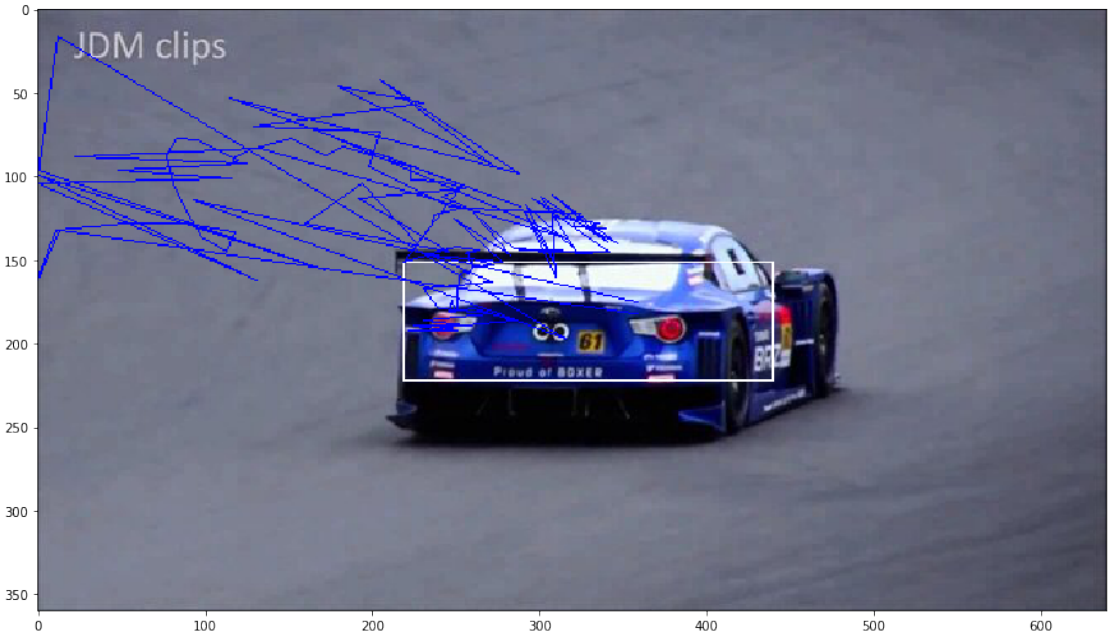
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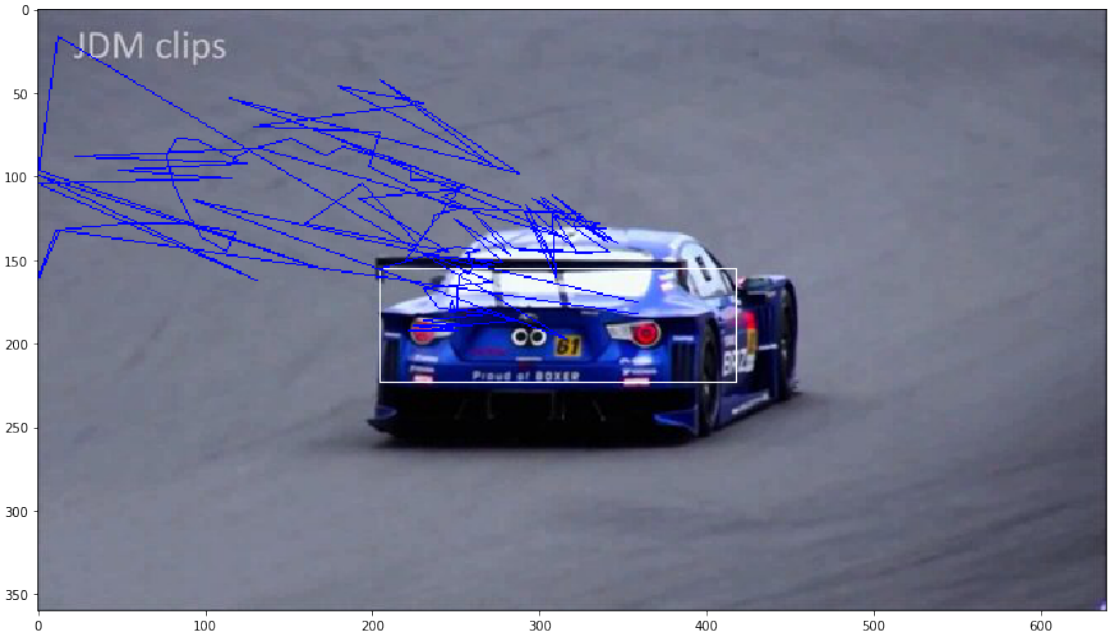
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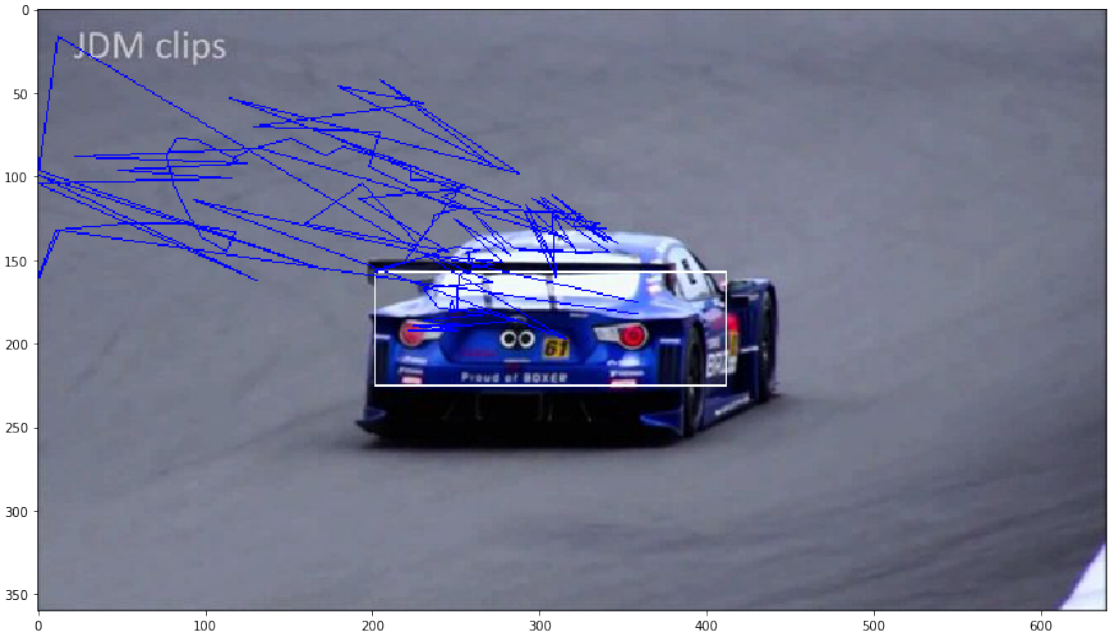
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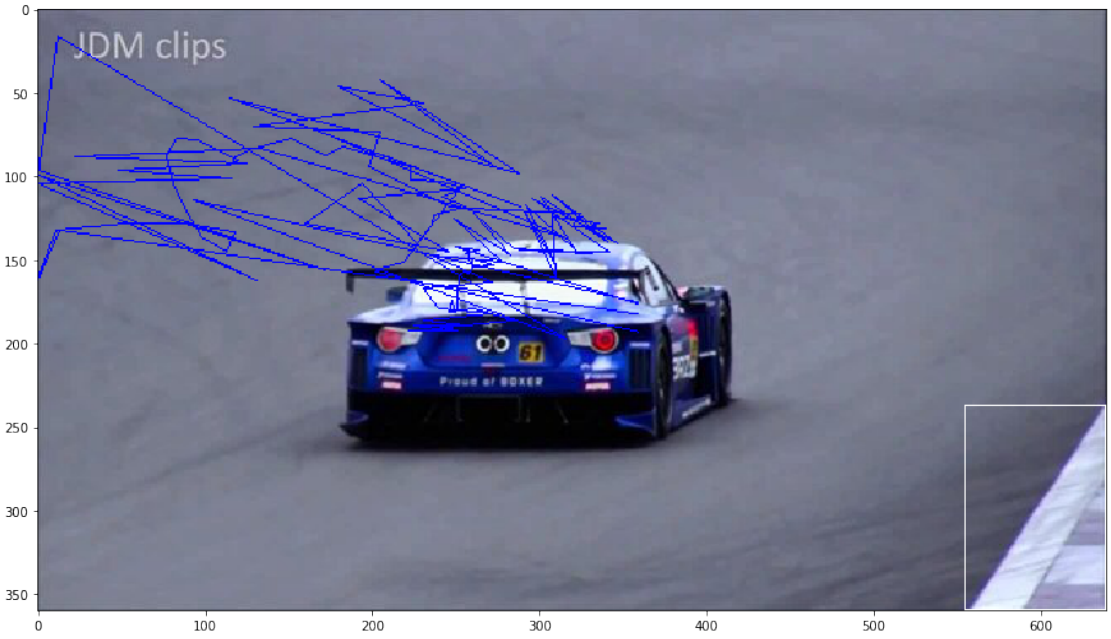
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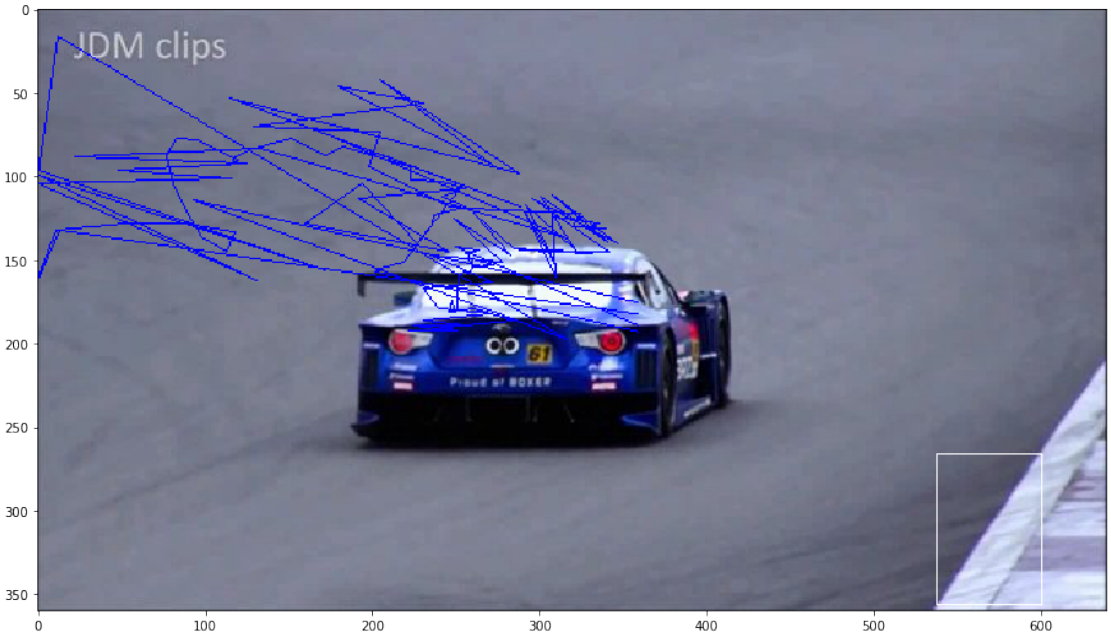
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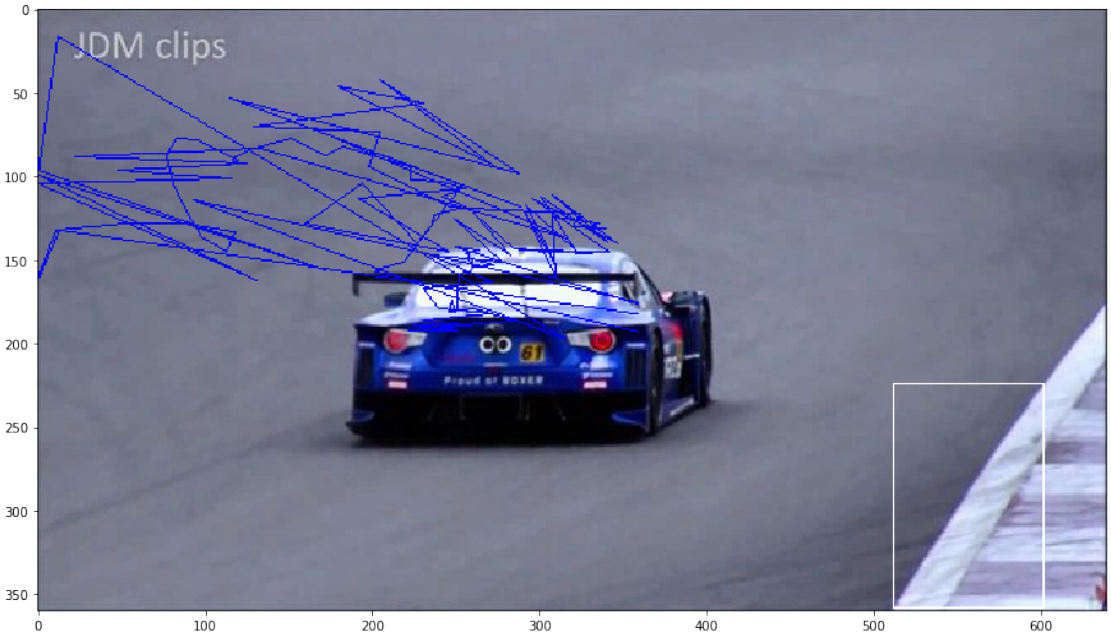
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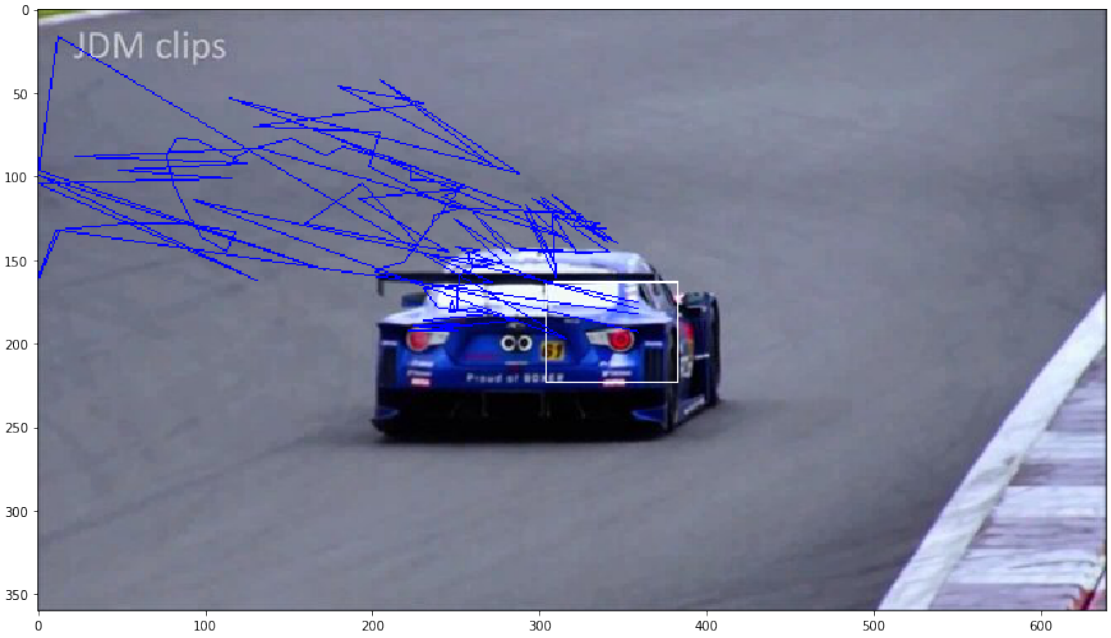
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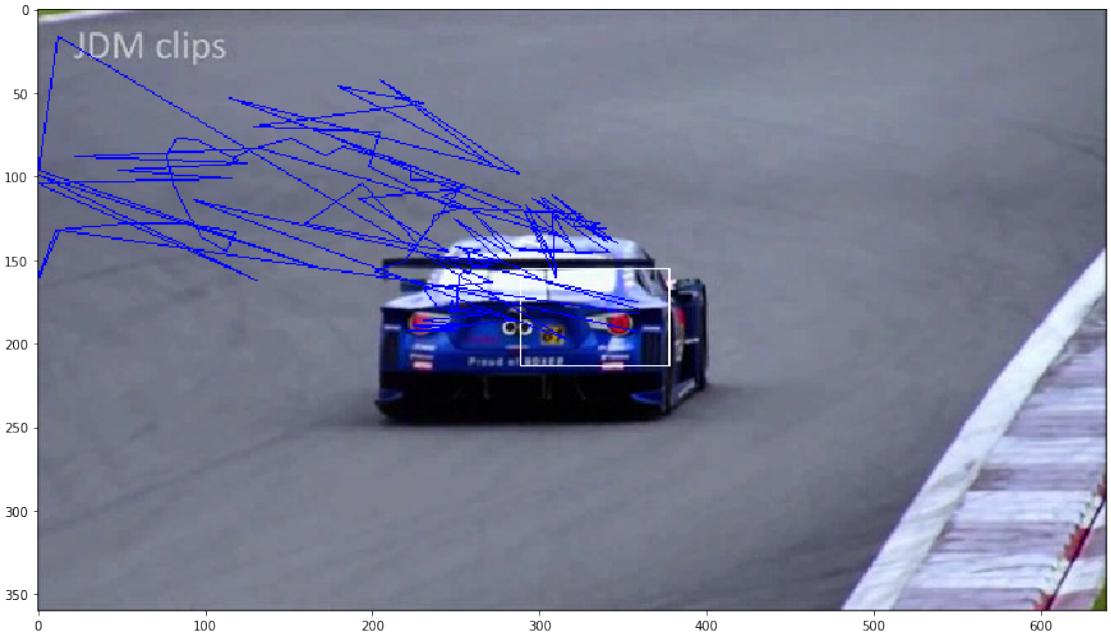
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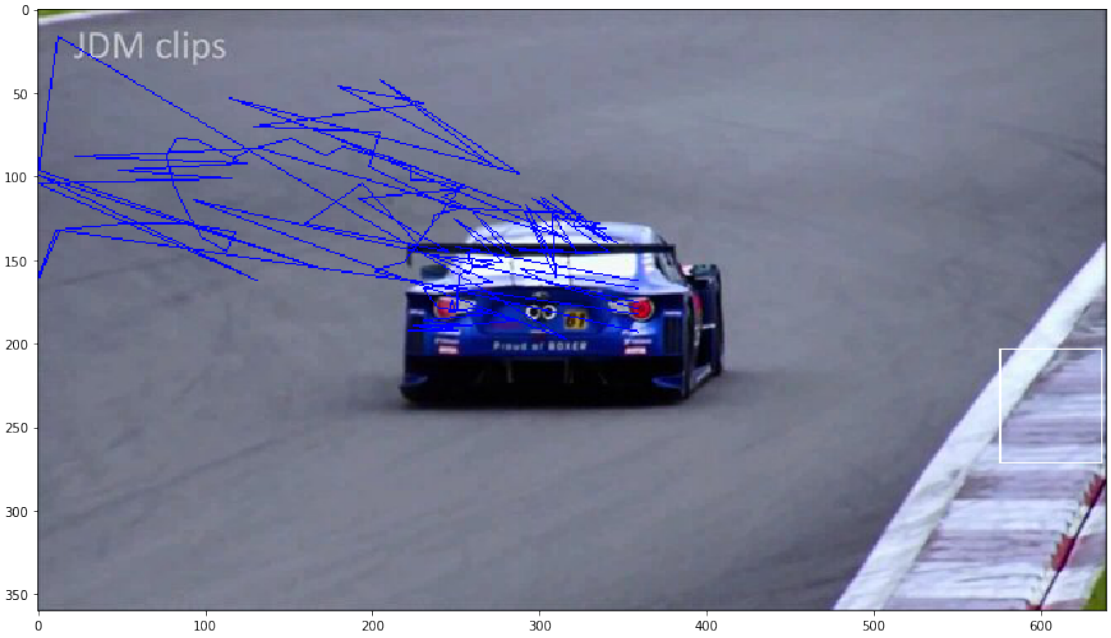
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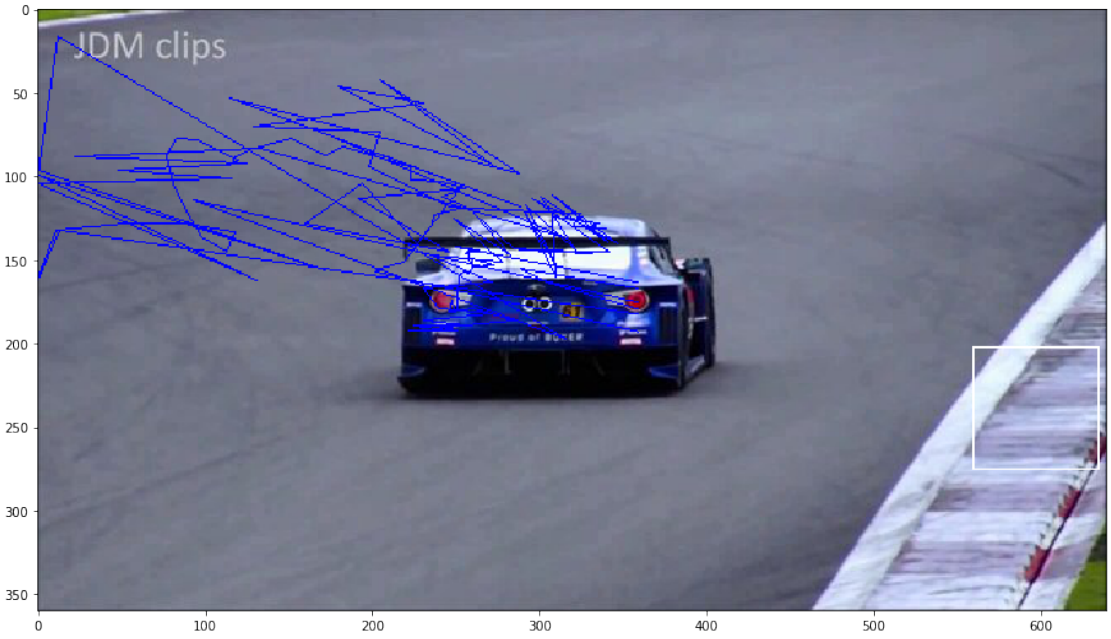
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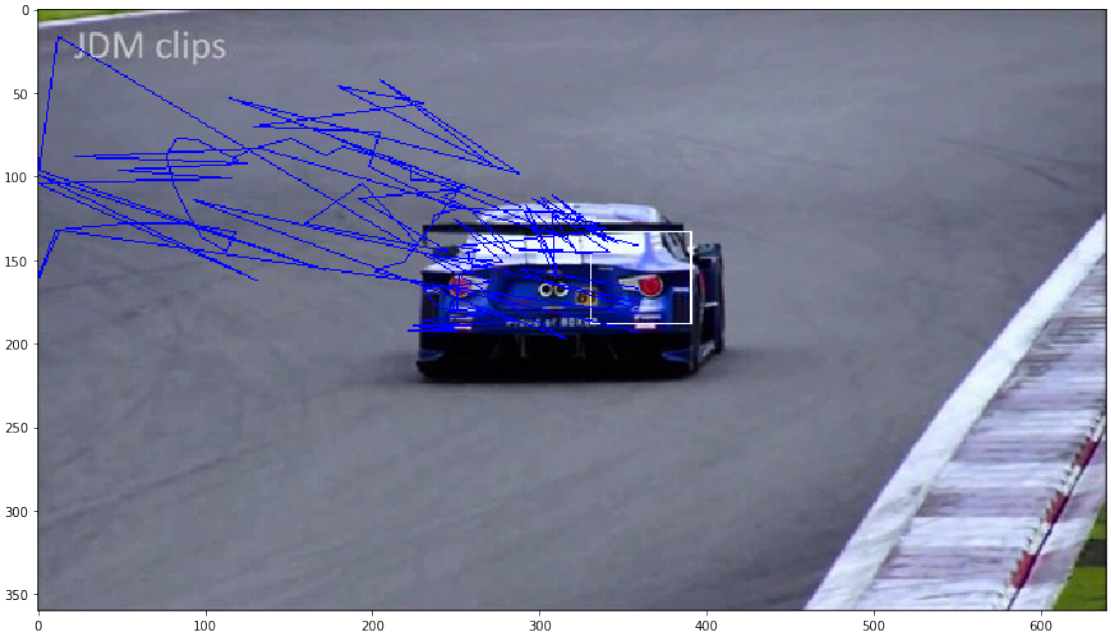
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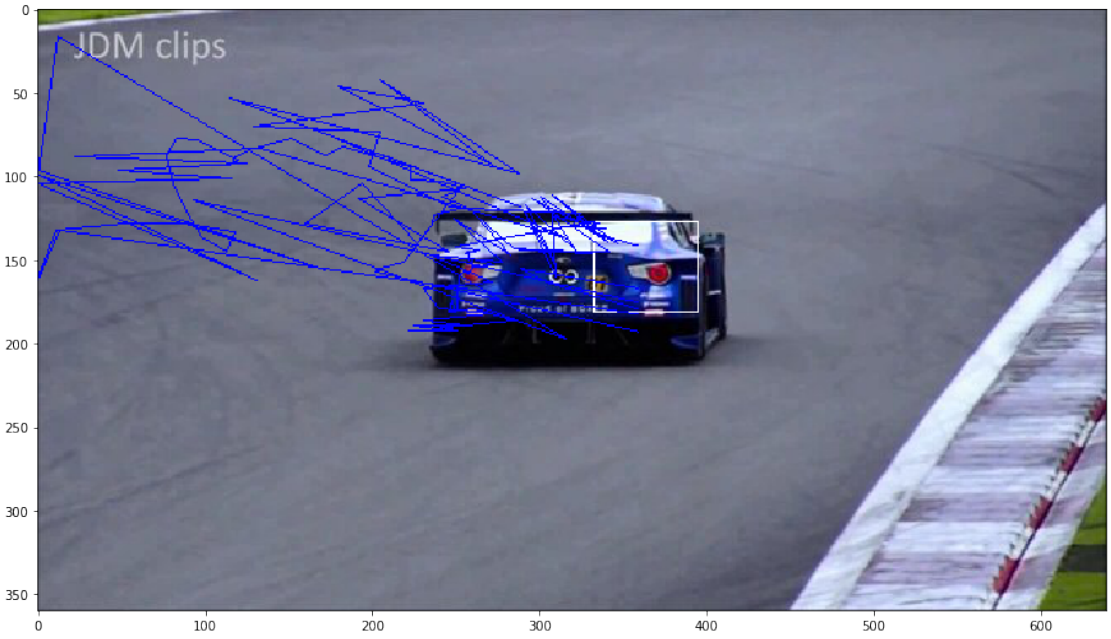
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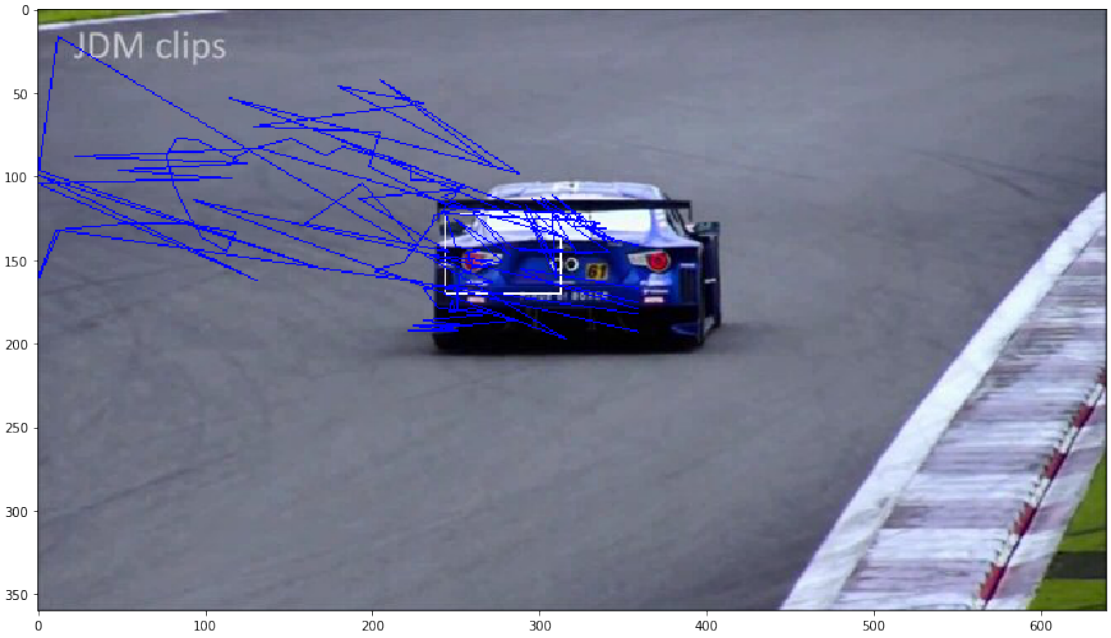
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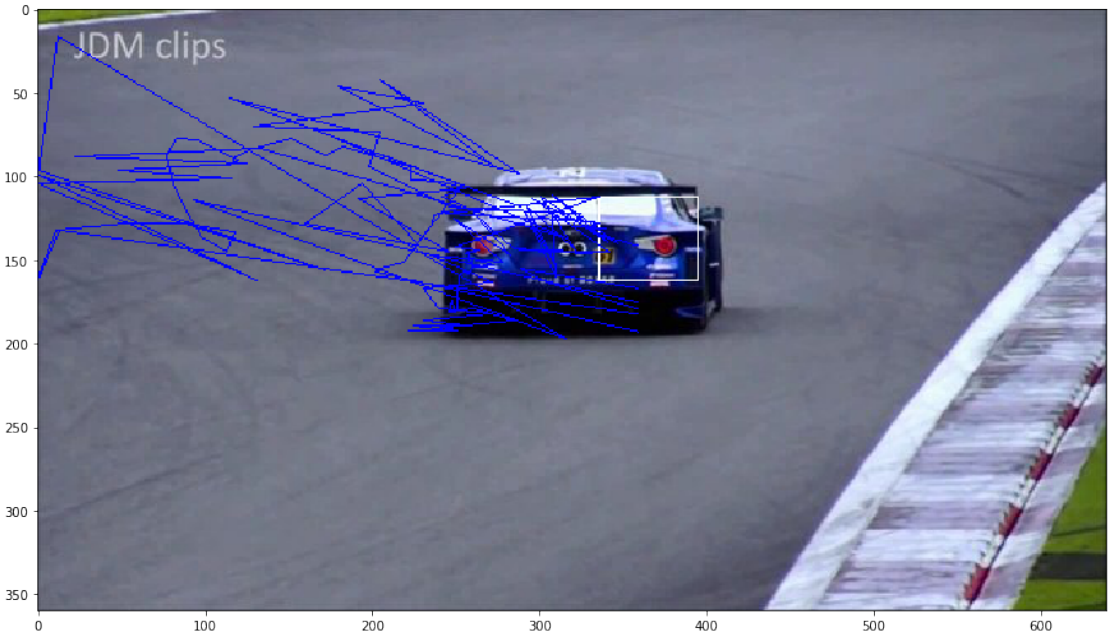
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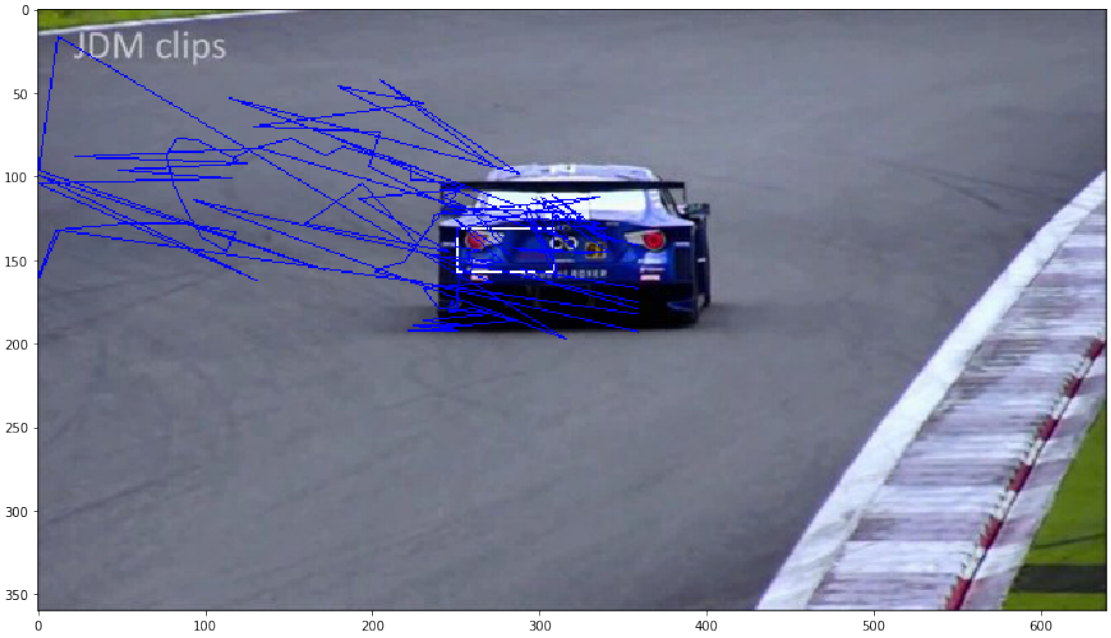
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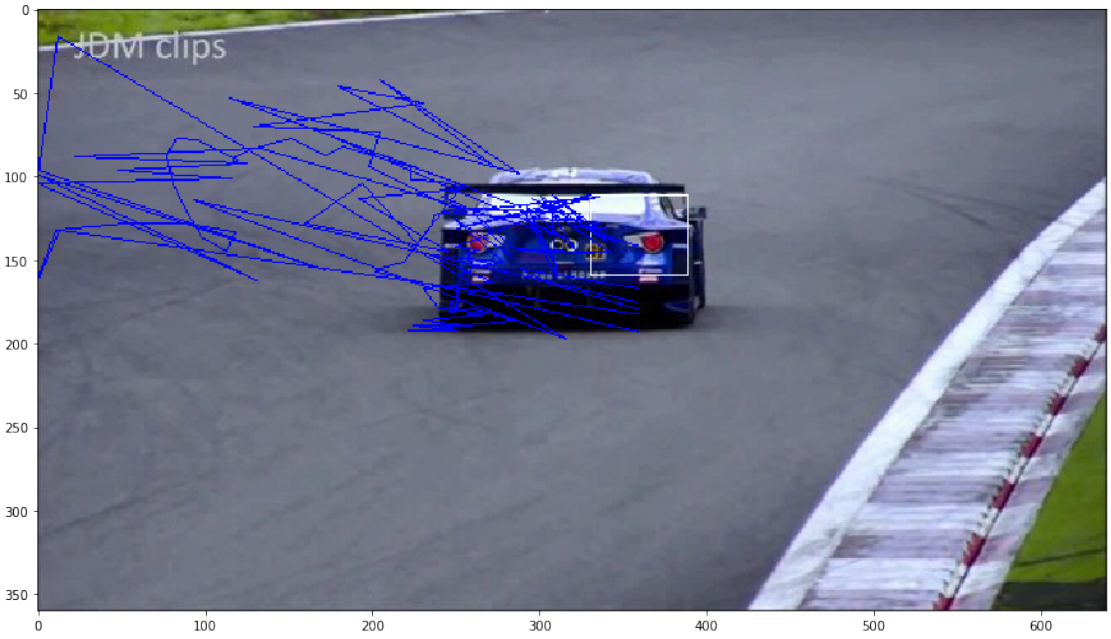
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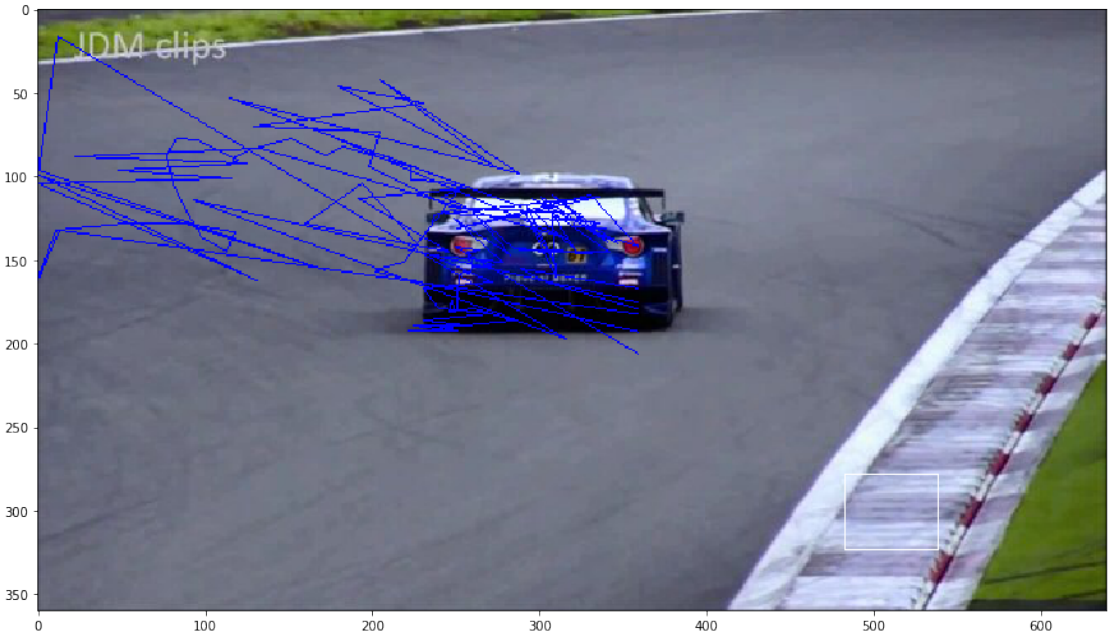
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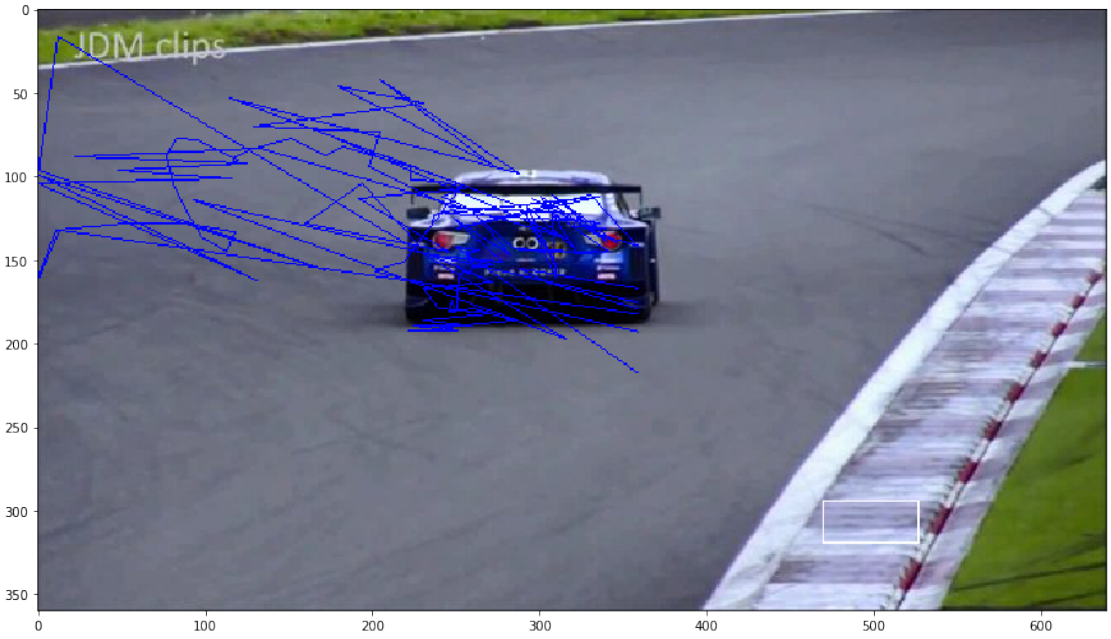
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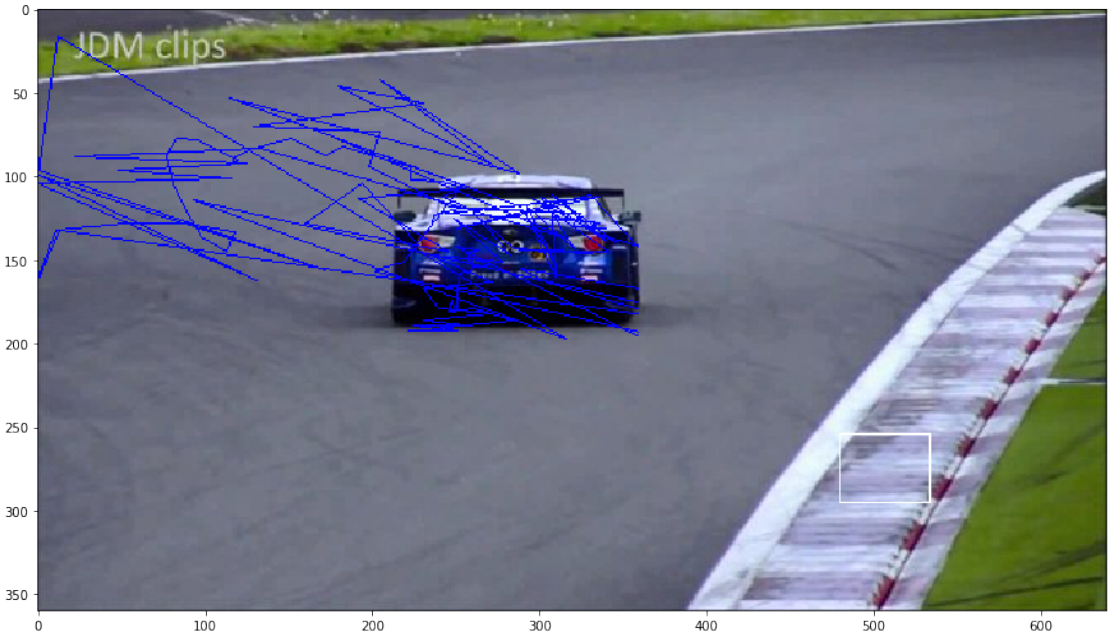
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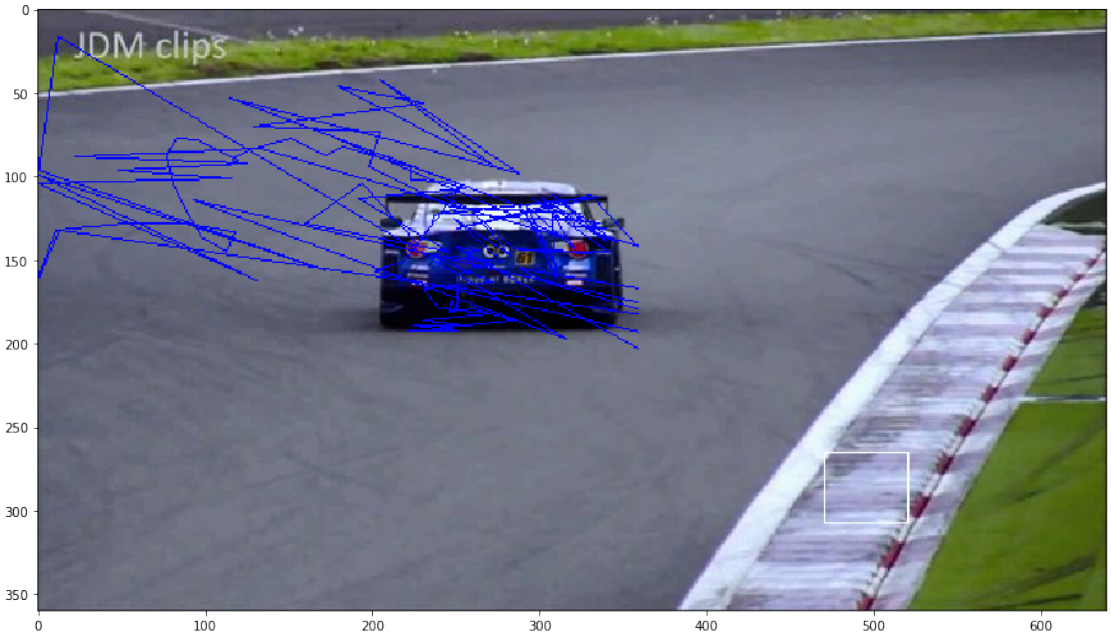
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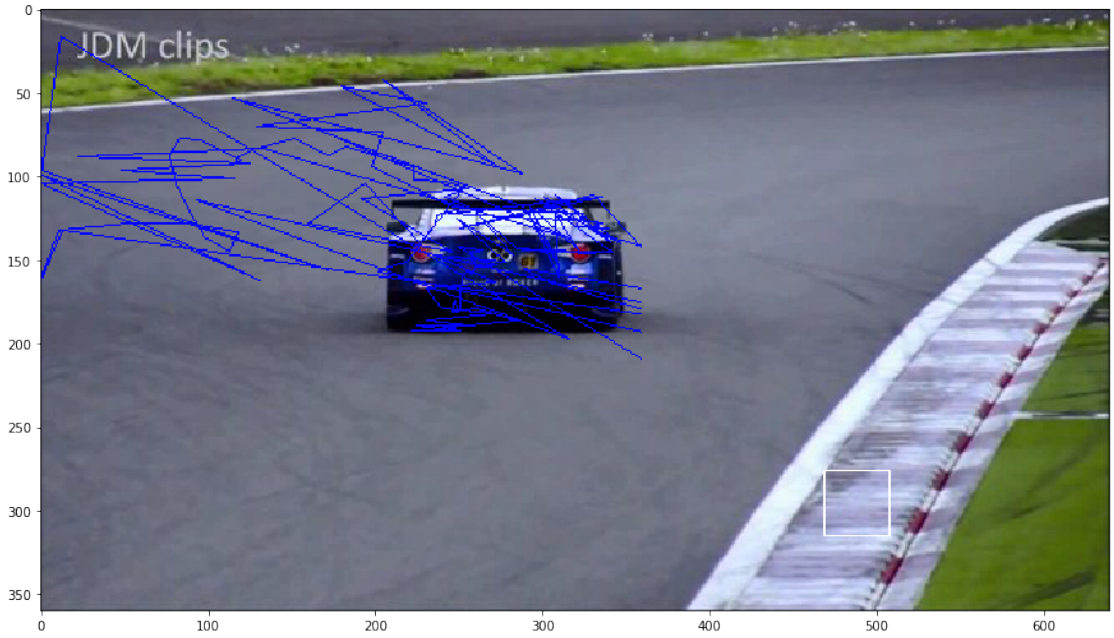

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