

Advanced Computer Vision – HW1

Image Matching (Detecting Motion Vectors)

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1. Description

- Given two images: trucka.bmp, truckb.bmp.

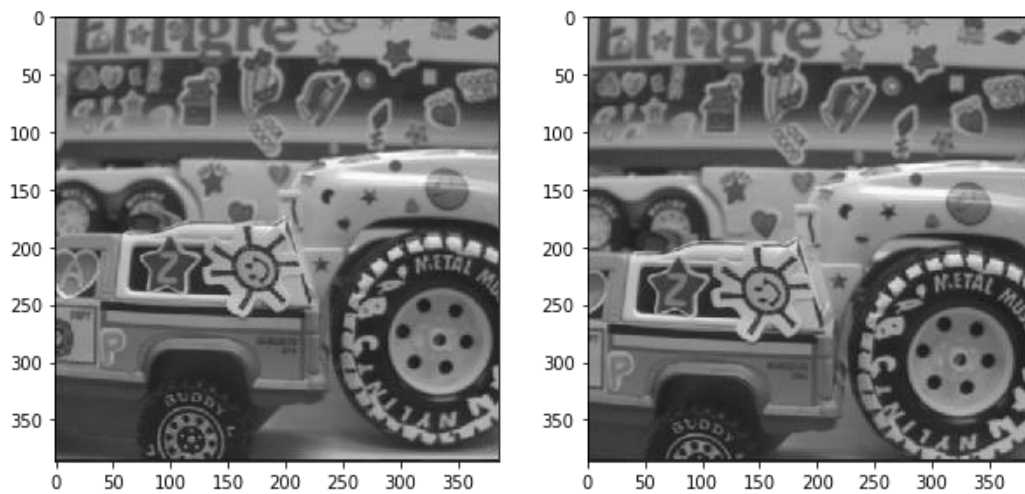


Figure 1. trucka.bmp (left), truckb.bmp (right).

- Detect motion vectors between trucka.bmp and truckb.bmp.
- Use trucka.bmp as the basis, sample it by an 9×9 , 11×11 , 15×15 , 21×21 , 31×31 block.
- Threshold of search range: 50 pixels. (This is a reference value only.)

2. Method

- The algorithm we used is Template Matching.
- Cal_block_position* function:

This function helps to divide trucka.bmp into several blocks as template.

```
def cal_block_position(image, block_size, stride):  
    position_list = []  
    block_list = []  
    for r in range(0, image.shape[0] - block_size, stride):  
        for c in range(0, image.shape[1] - block_size, stride):  
            position_list.append([r, c])  
            block_list.append(image[r:r+block_size, c:c+block_size])  
    return position_list, block_list
```

- *cal_motion* function:

This function helps to calculate the motion vectors. For each template in trucka.bmp, it will be compared with all the blocks within the search range in truckb.bmp. The best match is the block which has the least sum of absolute difference with the template block.

```
def cal_motion(position_list_a, block_list_a, position_list_b, block_list_b, search_range):
    motion_list = []
    for position_a, block_a in zip(position_list_a, block_list_a):
        min_diff = 9999999
        for position_b, block_b in zip(position_list_b, block_list_b):
            distance = np.sqrt((position_a[0]-position_b[0])**2 + (position_a[1]-position_b[1])**2)
            if distance <= search_range:
                diff = np.sum(abs(block_a - block_b))
                if diff < min_diff:
                    min_diff = diff
                    match_position = position_b
        dx, dy = match_position[0] - position_a[0], match_position[1] - position_a[1]
        motion_list.append((dx, dy))
    return motion_list
```

3. Result

- Block size = 9×9

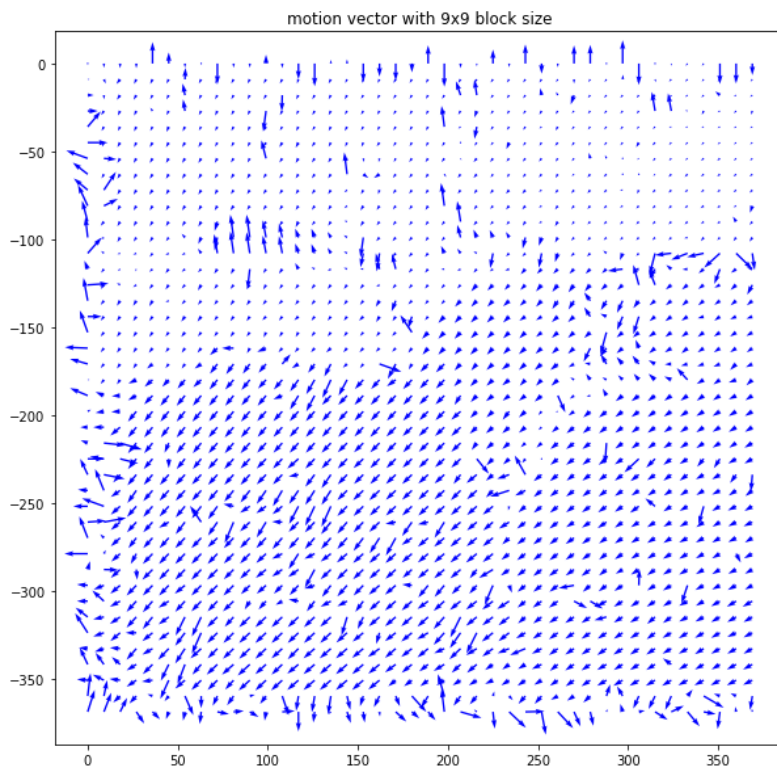


Figure 2. motion vector with 9×9 block size.

- Block size = 11×11

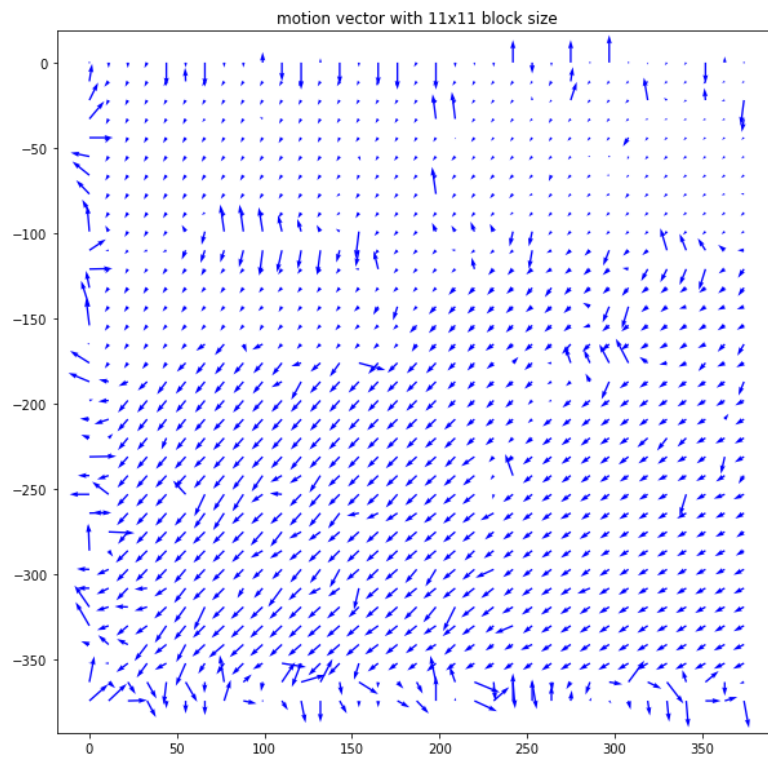


Figure 3. motion vector with 11×11 block size.

- Block size = 15×15

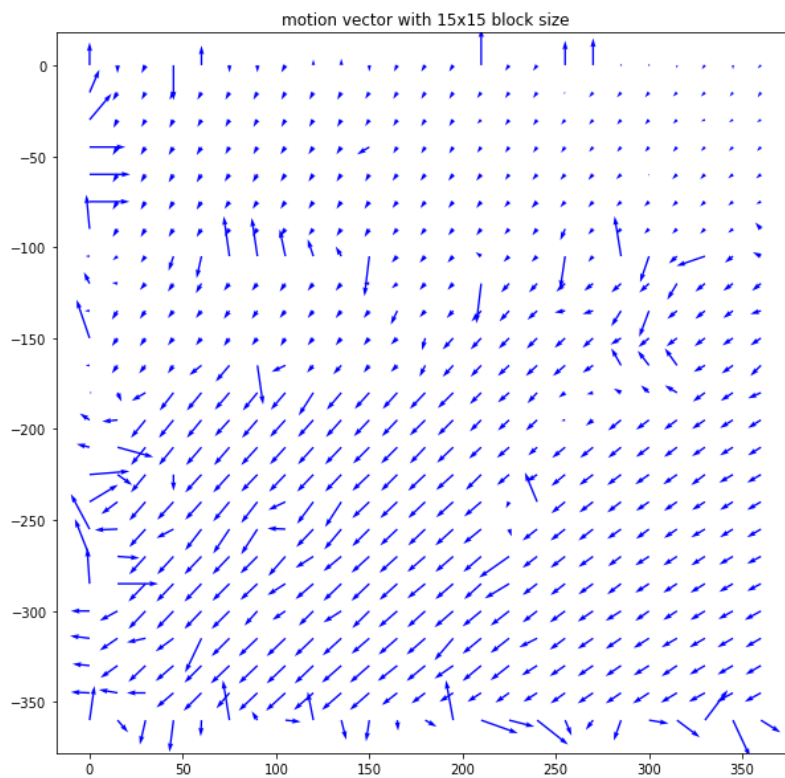


Figure 4. motion vector with 15×15 block size.

- Block size = 21×21

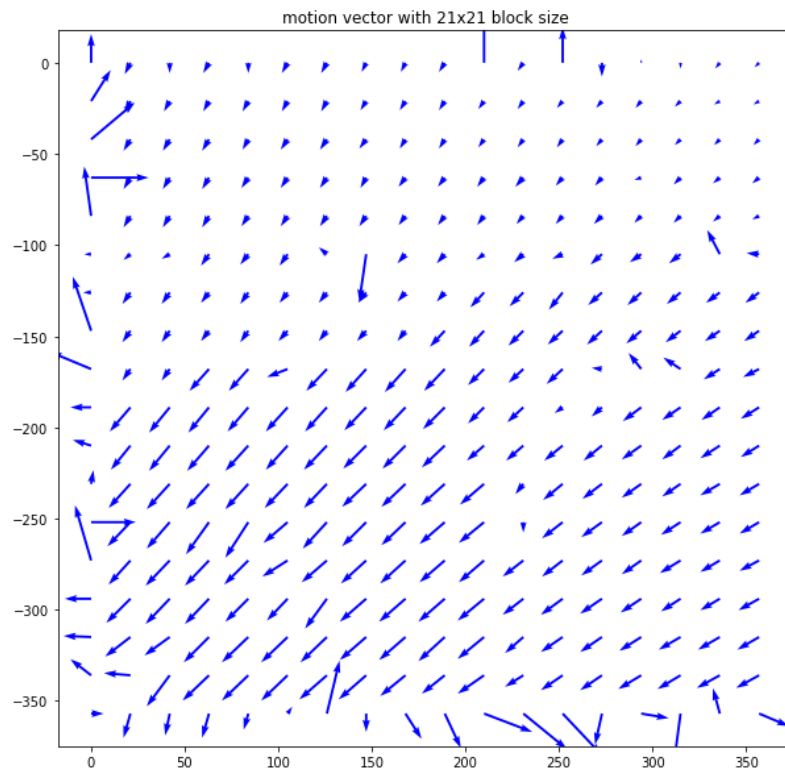


Figure 2. motion vector with 21×21 block size.

- Block size = 31×31

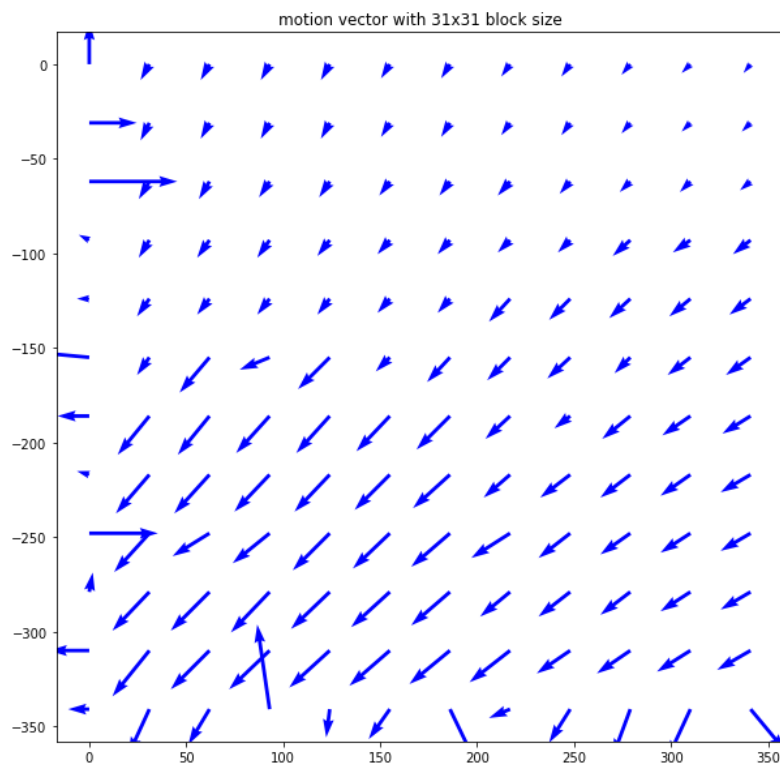


Figure 2. motion vector with 31×31 block size.