Robotics Assignment 4 (Group nilo)

The code for this assignment can be found in Assignment 4 on GitHub.

Assignment 4-2: Camera parameters (1 Point)

Code for extracting the camera parameters is in `export_camera.py`

```
{
    "fx": 383.7944641113281, "fy": 383.7944641113281,
    "cx": 322.3056945800781, "cy": 241.67051696777344,
    "k1": 0.0, "k2": 0.0, "t1": 0.0, "t2": 0.0, "k3": 0.0
}
```

Assignment 4-3: Binary Image (2 Point)

Code for the thresholding can be foundin `find_marks.py`
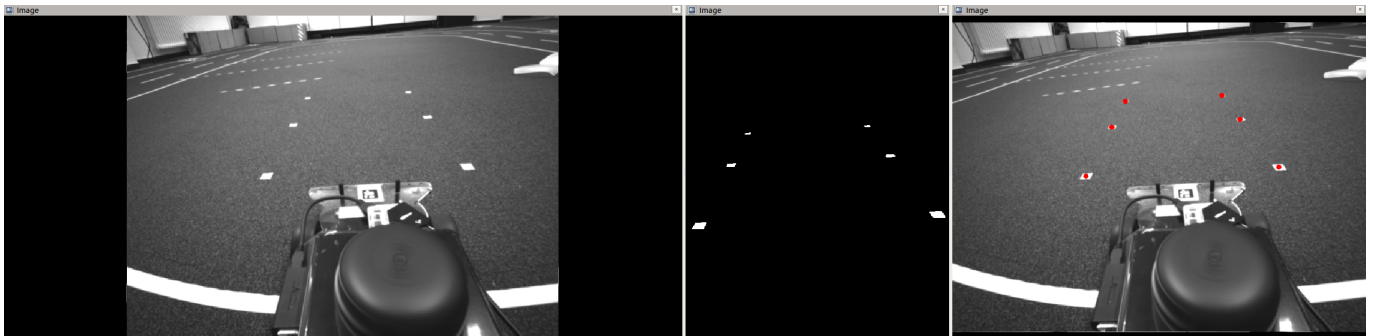
Assignment 4-4: Find white pixels (2 Points)

Code can be found in `find_marks.py`, see function `locate_marker`.

See above image for a visualization of the found points.

Assignment 4-5: Compute the extrinsic parameters (3 Points)

Code can be found in `find_marks.py`.

Screenshot of terminal output:

```
[INFO] [1573380058.103333]: rvec: [ 1.25048122  0.27427198  2.75678763], tvec: [-0.55660954 -0.05800234 -0.4664197 ]
[INFO] [1573380058.168146]: Marker positions: [[122, 267], [113, 416], [162, 246], [150, 444], [238, 206], [224, 504]]
[INFO] [1573380058.170093]: rvec: [ 1.25108954  0.27212703  2.75830463], tvec: [-0.55657399 -0.05596205 -0.46656142]
[INFO] [1573380058.236259]: Marker positions: [[122, 267], [113, 417], [162, 246], [150, 444], [238, 206], [224, 504]]
[INFO] [1573380058.238217]: rvec: [ 1.25048122  0.27427198  2.75678763], tvec: [-0.55660954 -0.05800234 -0.4664197 ]
[INFO] [1573380058.304070]: Marker positions: [[122, 267], [113, 417], [162, 246], [150, 444], [238, 206], [224, 504]]
[INFO] [1573380058.306184]: rvec: [ 1.25048122  0.27427198  2.75678763], tvec: [-0.55660954 -0.05800234 -0.4664197 ]
[INFO] [1573380058.370494]: Marker positions: [[122, 267], [113, 417], [162, 246], [150, 444], [238, 206], [224, 504]]
[INFO] [1573380058.372516]: rvec: [ 1.25048122  0.27427198  2.75678763], tvec: [-0.55660954 -0.05800234 -0.4664197 ]
[INFO] [1573380058.437148]: Marker positions: [[122, 267], [113, 417], [162, 246], [150, 444], [238, 206], [224, 504]]
[INFO] [1573380058.439028]: rvec: [ 1.25048122  0.27427198  2.75678763], tvec: [-0.55660954 -0.05800234 -0.4664197 ]
[INFO] [1573380058.504594]: Marker positions: [[122, 267], [113, 417], [162, 246], [150, 444], [238, 206], [224, 504]]
[INFO] [1573380058.507473]: rvec: [ 1.25048122  0.27427198  2.75678763], tvec: [-0.55660954 -0.05800234 -0.4664197 ]
[INFO] [1573380058.570804]: Marker positions: [[122, 267], [113, 417], [162, 246], [150, 444], [238, 206], [224, 504]]
[INFO] [1573380058.572259]: rvec: [ 1.25048122  0.27427198  2.75678763], tvec: [-0.55660954 -0.05800234 -0.4664197 ]
[INFO] [1573380058.639212]: Marker positions: [[122, 267], [113, 417], [162, 246], [150, 444], [238, 206], [224, 504]]
[INFO] [1573380058.641228]: rvec: [ 1.25048122  0.27427198  2.75678763], tvec: [-0.55660954 -0.05800234 -0.4664197 ]
[INFO] [1573380058.705212]: Marker positions: [[122, 267], [113, 417], [162, 246], [150, 444], [238, 206], [224, 504]]
[INFO] [1573380058.706825]: rvec: [ 1.25048122  0.27427198  2.75678763], tvec: [-0.55660954 -0.05800234 -0.4664197 ]
[INFO] [1573380058.772983]: Marker positions: [[122, 267], [113, 417], [162, 246], [150, 444], [238, 206], [224, 504]]
[INFO] [1573380058.775179]: rvec: [ 1.25048122  0.27427198  2.75678763], tvec: [-0.55660954 -0.05800234 -0.4664197 ]
[INFO] [1573380058.841574]: Marker positions: [[122, 267], [113, 416], [162, 246], [150, 444], [238, 206], [224, 504]]
[INFO] [1573380058.843772]: rvec: [ 1.25108954  0.27212703  2.75830463], tvec: [-0.55657399 -0.05596205 -0.46656142]
[INFO] [1573380058.909129]: Marker positions: [[122, 267], [113, 417], [162, 246], [150, 444], [238, 206], [224, 504]]
[INFO] [1573380058.911138]: rvec: [ 1.25048122  0.27427198  2.75678763], tvec: [-0.55660954 -0.05800234 -0.4664197 ]
[INFO] [1573380058.975606]: Marker positions: [[122, 267], [113, 417], [162, 246], [150, 444], [238, 206], [224, 504]]
[INFO] [1573380058.977640]: rvec: [ 1.25048122  0.27427198  2.75678763], tvec: [-0.55660954 -0.05800234 -0.4664197 ]
[INFO] [1573380059.042788]: Marker positions: [[122, 267], [113, 417], [162, 246], [150, 444], [238, 206], [224, 504]]
[INFO] [1573380059.044826]: rvec: [ 1.25048122  0.27427198  2.75678763], tvec: [-0.55660954 -0.05800234 -0.4664197 ]
```

Assignment 4-6: Finding the camera pose (2 Points)

The rotation matrix computed from `Rodrigues` is:

```
R = [[-0.65717015 -0.01834538  0.75351897]
 [ 0.16645099 -0.97855496  0.12134353]
 [ 0.73513364  0.20516733  0.64613072]]
```

Hence the homogeneous transformation matrix is:

```
H = [R | t]
    [0 | 1]
```

Plugging in `R` and `t`, we get:

```
H = [
    [-0.657 -0.018  0.754, -0.556]
    [ 0.166 -0.979  0.121, -0.058]
    [ 0.735  0.205  0.646, -0.466]
    [ 0      0      0       1    ]
]
```

And the inverse is:

```
H_-1 =
    [-0.65701163,  0.1661405 ,  0.73573338, -0.01281056],
```

```
      [-0.01829467, -0.97827345,  0.2045902 ,  0.02842734],
      [ 0.75333429,  0.12141298,  0.64596745,  0.72691665],
      [ 0.        ,  0.        ,  0.        ,  1.        ]]
```