

PROGRAMMING (7 points)

The Hough transform can be used to detect easy geometric shapes. So far, we have used Hough transform to extract straight lines. In this exercise, we will detect circles using the Hough transform.

This is the last possible exercise for presenting in block II . For the presentation it is sufficient, if at least one coin and one pip is recognized and visualized correctly. However, this will for sure not give full seven points.

14. `imfindcircles` by **MATLAB** (7 points)

This exercise introduces `imfindcircles`, a function provided by MATLAB to perform circle hough transform. As mentioned in the lecture, the hough transform can not only be used to detect straight lines but also to detect other analytically describable shapes. Here we will use the circle hough transform to count coins and pips on dominoes. Both (coins and pips) have a circle shape but differ in the radius. We will write a function that detects those objects, visualizes the found circles and outputs the number of coins and pips in the image.

- a) Read the documentation of the function `imfindcircles` [1]. Try out the examples
 - Detect Five Strongest Circles in an Image
 - Draw Lines Around Bright and Dark Circles in Image
- b) Download the five images, which are available in the moodle course.
- c) Create a function file named

`countCoinsAndPips.m`

The header should look like:

```
1 function [numCoins, numPips] = countCoinsAndPips(I)
   %COUNTCOINSANDPIPS counts coins and pips in the input image
3 %   [numCoins, numPips] = countCoinsAndPips(I) gets a grayscale
   input
   %   image and returns the number of coins and pips on dominoes
   in the
5 %   image. Also a figure is opened, visualizing the found coins
   and dices.
```

This file can be found in the moodle course.

- d) In the function do the following steps:
- i. Apply Gaussian smoothing to the input image.
 - ii. Perform edge detection.
 - iii. Try to detect all the coins using `imfindcircle`. Make use of the arguments the function provides. Especially, defining the range of the radius is most helpful.
 - iv. Similiar, try to detect all the pips on the dominoes.
 - v. Create a figure, show the image and visualize the detected coins and pips. The result could look like figure 1.

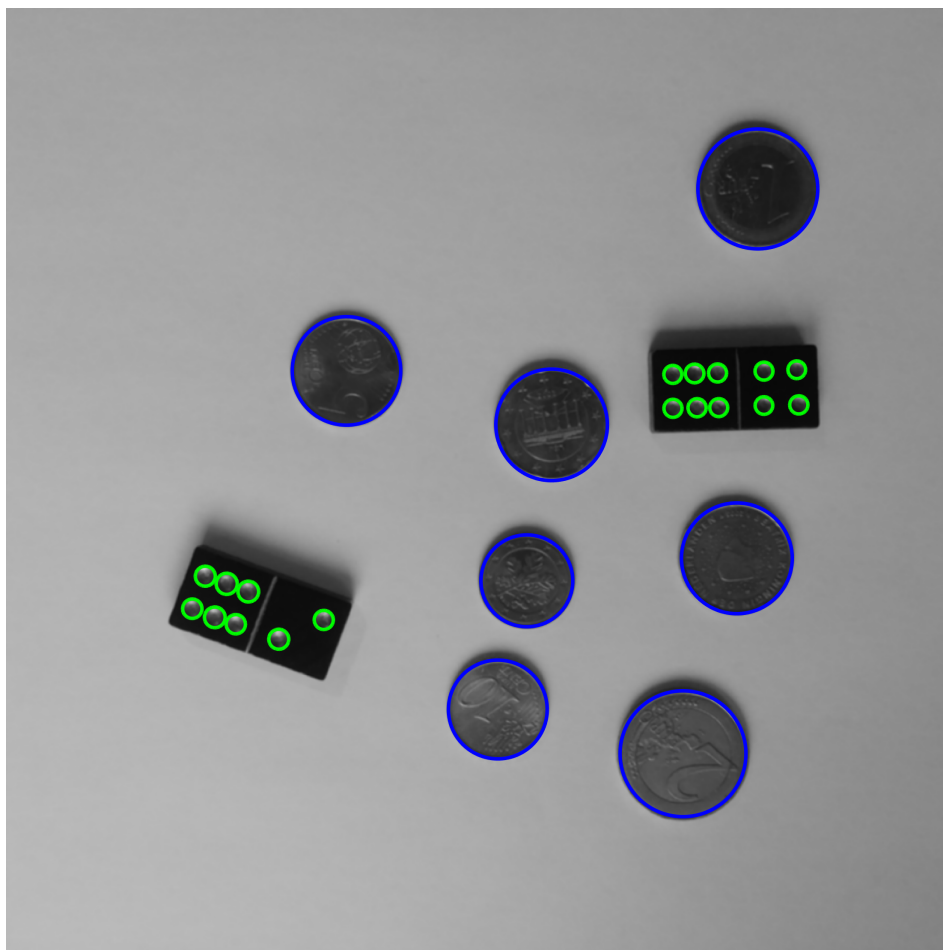


Figure 1: Good result for the detection of coins and pips in the first image using hough circle transform.

- vi. Return the numbers of coins and the number of pips in the output variables `numCoins` and `numPips`. Ideally, calling the function on the first image should give a result like this:

```
1 >> [numCoins, numPips] = countCoinsAndPips(imread('
    coinsandpips_1.png'))
3 numCoins =
5         7
7
9 numPips =
    18
```

and open a figure showing a visualization like in figure 1.

- e) Adapt your function `countCoinsAndPips` until it gives good results for all five test images. The grading will be based on how your function performs on the known five images and another unknown (but similar) image.

References

- [1] MathWorks Matlab Help. *imfindcircles: Find circles using circular Hough transform*. URL: <https://de.mathworks.com/help/images/ref/imfindcircles.html>.