SGN-3056 Course: Digital Image Processing 2

Shape Recognition Lab – Research Report (Category 3)

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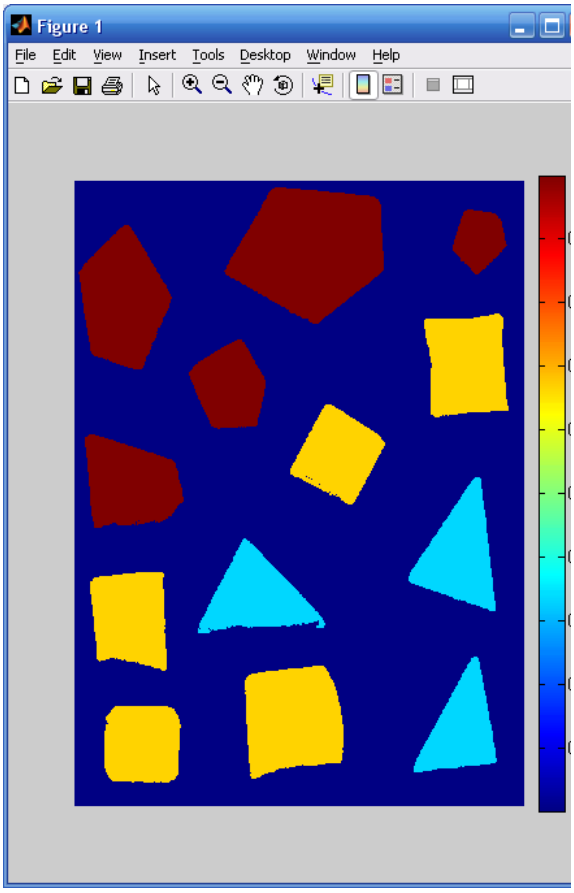
Our alternative method for recognizing the shape of the scanned objects is based on detecting the corner points of the shape. Therefore, this method does not make use of any test data but examines the second derivative of the boundary coordinates. In particular, it calculates the roots of the corresponding vector. We decided to use this method, after recalling the ideal shape of the x- and y-coordinate vector of the boundary:

- When traversing an edge, x- and y-coordinates are linearly increasing/decreasing or constant. During this, the first derivative of the x- and y-coordinate is constant.
- If we come to a corner point, the ascent of x- or y-coordinate or both is changing, resulting in a change of their first derivative.
- We now traverse the x- and y-derivative, looking for such a "jump".
- But there is a problem: the coordinates are discrete values; furthermore, they are very noisy: edges may have some small distortions, which we don't want to be recognized as edges. To solve this, we smooth the boundary vector with a simple mean filter.
- Also corners may be rather "round" then sharp. To overcome this problem, we do not exactly detect the "jumps", but we move a sliding window over the derivative and compute the maximum difference of the points inside the window from their average.
- From this vector, we compute the average and detect the regions, where the value is above average.

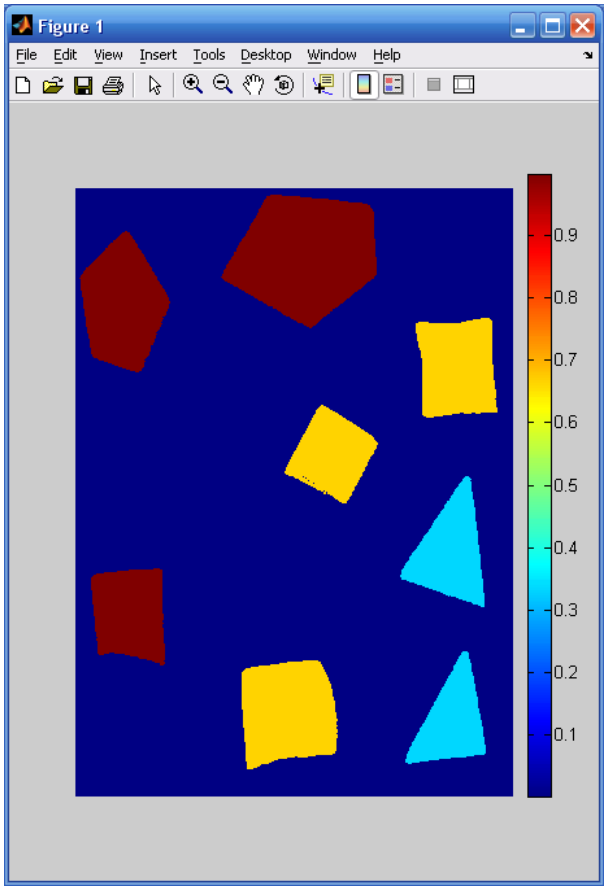
Our method has advantages and disadvantages: First, it works without training data. On the other hand, there is a certain thread-off: On one hand side, the boundary vector might be too noisy, so corners might be recognized as such, which actually are no corners. On the other hand side, a object might be too small and the corner too much smoothed. In this case, some corners are not recognized as such.

Because of that, our method did not always work well and some objects are not recognized. But with further improvements, this method could become much more useful: For example, one could use more advanced techniques for boundary recognition or more adaptive filters than a simple mean filter or the use of the median, when detecting the corners in the maximum-difference vector.

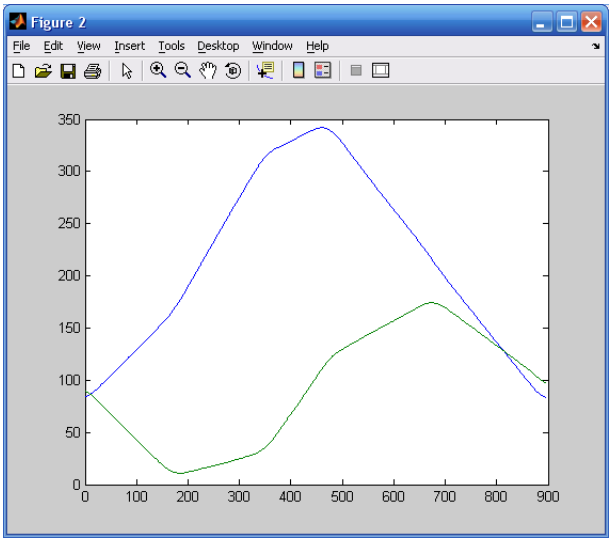
Nevertheless, we think, that we did a good job with this method. See some explaining pictures on the next page.



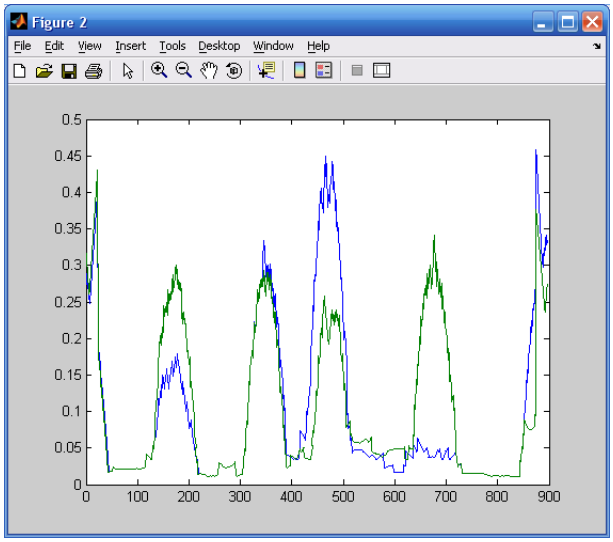
The “category 2 result”: shape recognition using the fourier descriptors



Our approach: especially small objects or objects with some “kinks” in their edges are not recognized, but this method works without training data.



The smoothed boundary coordinates X and Y of the pentagon (the upper left one in the figure above).



Maximum difference of the points inside a sliding window from the average of this sliding window. Note the 5 peaks.