Institut für Photogrammetrie und GeoInformation

Leibniz Universität Hannover

Photogrammetric Computer Vision (PCV)

Lab 3

Background Subtraction

Background Subtraction is a key element in many algorithms used in the context of image sequence analysis. The distinction between image background and foreground is, for instance, a meaningful cue for the detection and tracking of pedestrians in video surveillance.

The goal of this exercise is to obtain an advanced understanding of the approaches for background subtraction presented in the lectures. The exercise involves the modelling of the background and the decision for every pixel whether it belongs to the foreground or to the background. The background model to be used for this exercise is the "Single Gaussian" model.

Given data:

- Image sequence of a surveillance camera in a station

Programming Task:

- Implementation of the sequential estimation for the parameters of a single Gaussian (mean and variance).
- Implementation of the background/foreground labelling process for every pixel using the variance of the background model (threshold at 2.5σ).
- Simple implementation of a noise reduction in the labels using morphological operations
- Evaluate the given image sequence with two different values for the learning rate α, where $\alpha_1 = 1/50, \alpha_2 = 1/1400$

Questions to be answered in written report:

- Apply the implementation of the background subtraction algorithm using a single Gaussian as a background model to the given image sequence. Display and watch the results to get an impression of the effects that can be observed. **Describe the results** you got after applying your implementation to the given image sequence concisely. **Observations about your results**, e.g., how results change with different learning rates, in which part of the image wrong labelling occurs more often, are also required to be **summarized**.

- Chose two meaningful image frames for which you show
  a) the background mean image,
  b) the background variance image,

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12. Januar 2020

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c) the difference image of mean background and current frame,
d) the binary foreground/background mask

for a learning rate 1/50. Indicate the frame numbers in the caption of the figure.

- Name the advantages and drawbacks of the single Gaussian model.

- Discuss the result of your implemented method when facing difficult cases (consider shadows, reflections, people/things standing still, etc.) and interpret the reason for 1 or 2 cases where pixels are wrongly labelled.

Each group of two students implements a small software tool in the provided Matlab framework that is able to determine the required values from the given image sequence.

The image sequence (~ 250 MB) and the Matlab file can be downloaded here:
https://www.dropbox.com/sh/whf5haze25mqtlq/AADgfsXLggl1hDOlsFbho8G_a?dl=0

Take note of the additional hints concerning the Matlab implementation in the accompanying PowerPoint slides of the lecture.

The discussion is required in written form (in English) and has to be submitted as printed version. Also submit the documented Matlab code via email to Lin Chen (chen@ipi.uni-hannover.de).

Deadline for the submission of the results: January 30th, 2020