VU COMPUTER VISION

ASSIGNMENT 2: MOTION ANALYSIS

Antonio J. Rodriguez-Sanchez, 20-April-2023

Deadline: 09-May-2023

Important note: This assignment can be done in groups of two people

1. (4 points) Understanding a paper. Read in deep the following optical flow paper: *"Robust Local Optical Flow for Feature Tracking"* (RLOF) by Senst, Eiselein and Sikora (2016). Answer the following (two pages long):
   a. Give a very brief description in your own words about what is the paper about.
   b. What is the problem that tries to solve?
   c. How does it solve it? Make connections to mathematical equations.
   d. Comment on the results

2. (5 points) Optical flow. Make a short video at the lowest resolution possible using your camera or cell phone. This video must contain motion, e.g. a person moving, a car in motion, a cat, ...

   a. Use the Lukas and Kanade code from the lecture and replace the Shi-Tomasi feature detector by SIFT. Compare with Shi-Tomasi and comment on the results. Code about Lukas and Kanade+Shi-Tomasi available from https://docs.opencv.org/3.4/d2/d1d/samples_2cpp_2lkdemo_8cpp-example.html#a24

   b. Implement a program that uses the RLOF dense optical flow estimation from question 1 and compare the results with Farneback's algorithm from the lecture, available from https://docs.opencv.org/3.4/d4/dee/tutorial_optical_flow.html.

   c. Your output should be optical flow images such as

Lukas and Kanade

Dense optical flow

Note that you may (or maybe not) have problems with memory (video is a sequence of many images), you should be able to handle that.

3. (6 points) Motion analysis using spatiotemporal filters. Use the video from question 2 and create a program that analyze motion using spatiotemporal filtering:

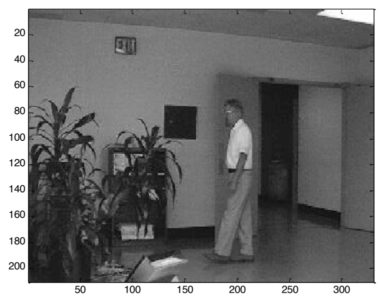
   a. Use the following spatiotemporal 9-tap filters from the classical work of Freeman and Adelson (1991):

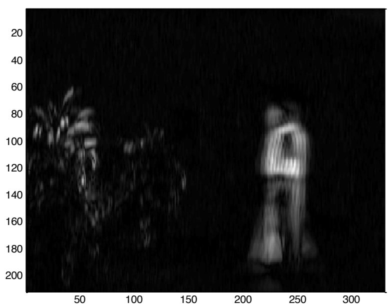
      f1={0.0094,0.1148,0.3964,-0.0601,-0.9213,-0.0601,0.3964,0.1148,0.0094}
      for the x dimension.
      f2 = {0.0008, 0.0176, 0.1660, 0.6383, 1.0, 0.6383, 0.1660, 0.0176, 0.0008}
      for the t dimension.

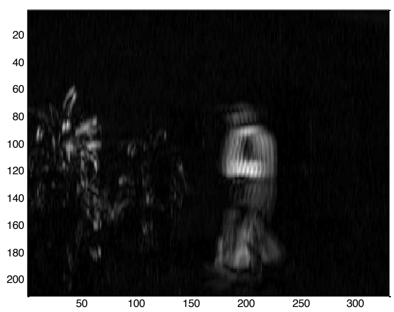
      Note: values taken from Appendix H in
      http://people.csail.mit.edu/billf/www/papers/steerpaper91FreemanAdelson.pdf

   b. Compare the spatiotemporal solutions with the Dense Optical flow solutions from question 2b and comment on how they compare.

   c. Your output should be a sequence of frames (video) such as the following (only the person and the plant leafs because of air conditioning are moving):







In summary, we extract the objects in motion

Note that you may (or maybe not) have problems with memory (video is a sequence of many images), you should be able to handle that.

Deliverable: PDF Document with the following:

Pages 1 and 2 (Understanding a paper)

Answers to exercise 1.

Page 3-7 (Optical flow):

Report on how your solution was implemented (including equations) and the algorithms you followed to solve the assignment. Include snippets (only interesting parts of the code) and snapshots of frames regarding the optical flow output solutions. Comment on the results and how the algorithms compare.

Pages 7-9 (Spatiotemporal filtering)

Report on how your solution was implemented (including equations) and the algorithm you followed to solve the assignment. Include snippets (only interesting parts of the code) and snapshots of frames regarding the spatiotemporal output solution. Comment on the results and how the algorithm compares to dense optical flow.

Page 10 (Discussion)

What you learnt about this assignment? and how the method can be improved or extended? What problems did you run into?.

Deliverlable: code (Python, C++) - along the PDF – that you use to solve the assignment.

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