Theory Practical 2023

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These guiding questions are just a skeleton of sorts with two main goals: background knowledge for presentation content, and hopefully bridging the gap for people with less image analysis experience. Feel free to include, exclude, add, and modify what's actually included in your presentation as you see fit.

Images

a

What's an array and in 'array' language' what is actually happening when you crop, mirror, rotate, transform, and invert an image?

b

Think of three biological research situations where binarisation and thresholding are applicable (xp if there are nice visuals to go with it).

c

Explain intra- and inter-class variance and it's relevance here.

d

Task 1 in notebook: Use Otsu thresholding and connected component detection to find true blobs in the example images.

e

Task 2 in notebook: devise a way to use 3-channel thresholding and connected component detection to count the number of players in orange on the field.

f

Find a different more sophisticated method/algorithm/package for blob detection and explain why it's probably superior to simple binary thresholding.

f

Task 3 in notebook: Apply this (or any method) to detect the fluorescent nuclei.

Videos

a

Explain how motion vectors arise when you have a video instead of an image.

b

What is a 3D to 2D motion field and what is apparent velocity?

c

P(t) is a moving point in space. p(t) is P projected in our 2D image. V = dP/dt and v is the apparent velocity in the 2D image. Differentiate:

$$p = f\frac{P}{Z}$$

p with respect to t to show apparent velocity is a function of Z (depth) and 3D motion.

d

Task 4 in notebook: Apply dense optical flow to the example bird video.

3

Explain briefly what sparse vs. dense optical flow achieves.

Challenge Tasks (recommended for afternoon 2)

You may already know OpenCV and other sources already have much more advanced packages for object detection and tracking, so in a mini-hackathon style, please use any and all existing tools now and just have some fun.

Generate and analyse your own videos

- Put a colourful hat or piece of clothing on a friend (or enemy).
- Take a non-panning, non-zooming video in which they move around with whatever movements they please.
- Track them in the video.
- Find conditions and modifications where tracking becomes more difficult.

Make a video tracking something that allows you to extract one or more set of longitudinal features, for example:

- Put the colourful hat or piece of clothing back on your friend or enemy.
- Take a video in which they run around within the frame chasing a laser.
- Generate a graph of their speed over time.

Alternatively,

- Find a video of your choice in which there is anything else moving around that you wish to track.
- Go ham with tracking, and remember to extract one or more set of longitudinal features.