Computer Vision Course — A.A. 2020/2021

Lab 2:

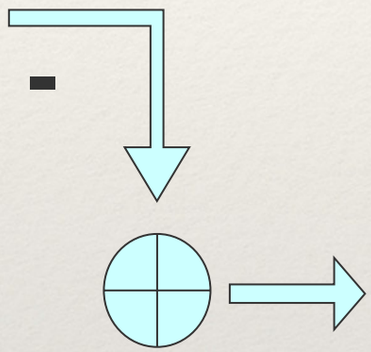
Motion Detection

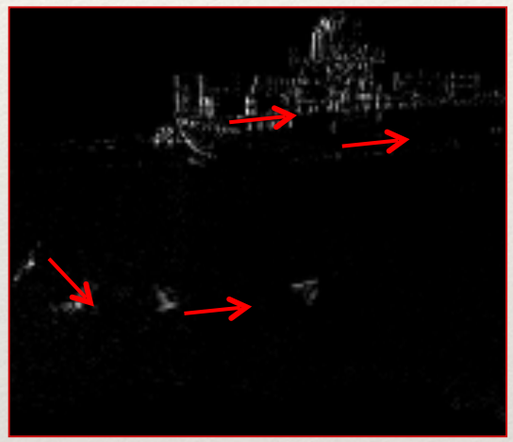
Niccolò Bisagno
niccolo.bisagno@unitn.it

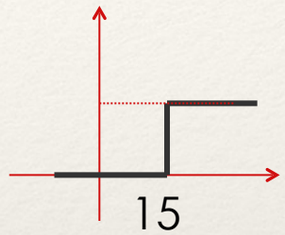
What's up today (and tomorrow)

- Frame differencing
- Background Subtraction
- Adaptive Background Subtraction
- Adaptive Background Subtraction: Mixture of Gaussians

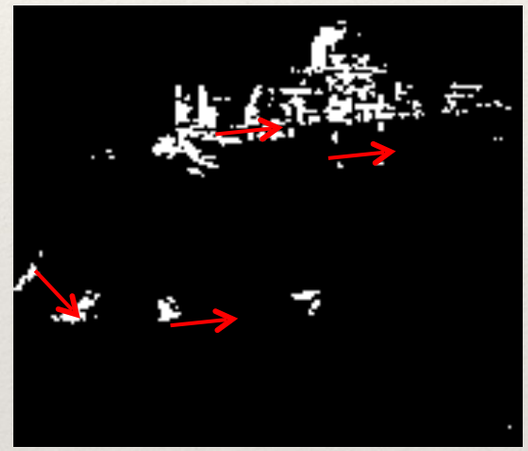
Frame differencing







Threshold



Areas in the image where a change has been detected

Threshold to reduce noise

Frame Differencing: Time Scaling

$$D(N) = \left\| I(t) - I(t+N) \right\|$$

Exercise: frame differencing

- Initialise a new project
- Open a video
- Convert frames to grayscale

  frame_gray = cv2.cvtColor(frame_color, cv2.COLOR_RGB2GRAY);
- Use a list to store frames!

  frames = [ ]

  NB!!!: how to append frames to array: frame.append(frame_gray);
- Implement the function

  result = cv2.absdiff(I(t),I(t+N))

$$D(N) = \left\| I(t) - I(t+N) \right\|$$

What's missing in the implementation?

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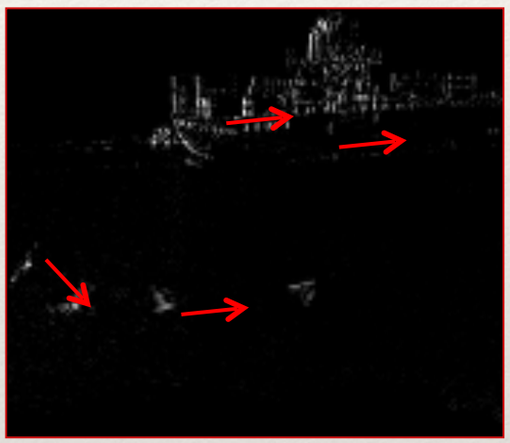
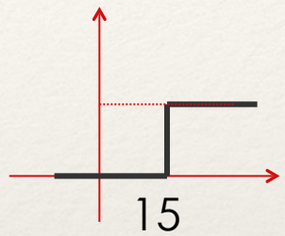
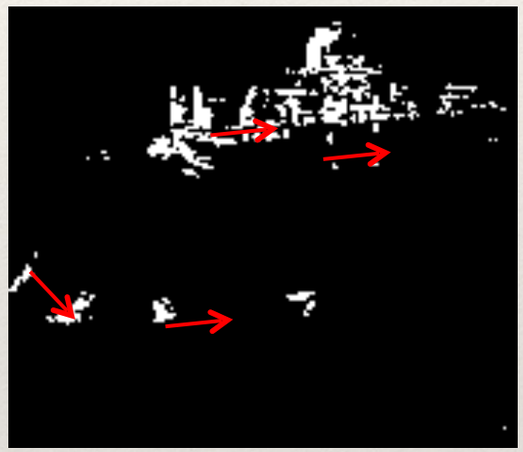
+



Areas in the image where a change has been detected

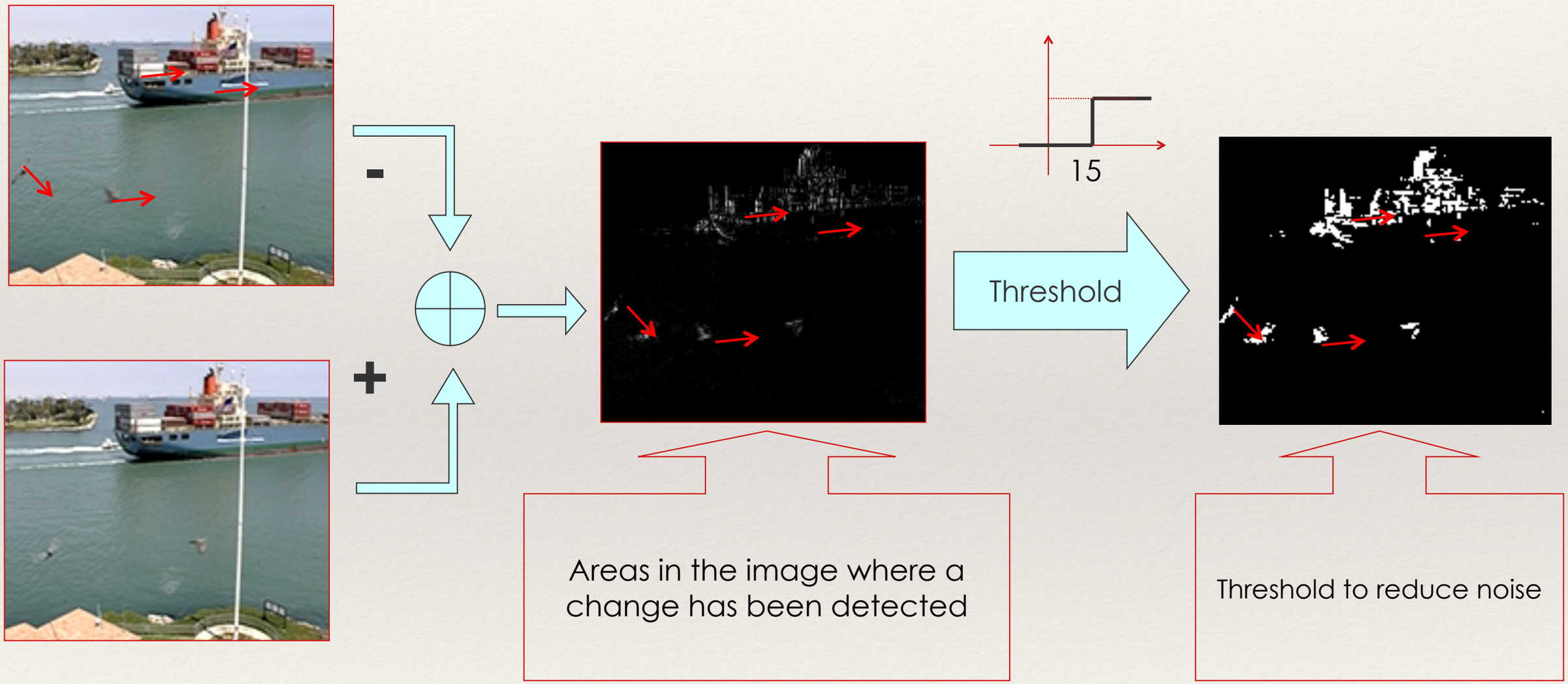


Threshold



Threshold to reduce noise

Apply thresholding on the mask



- cv2.threshold(image, double thresh, double maxval, int type)

Adaptive Background Subtraction

- Use a parameter α to weight the contributions
- $B_t = \alpha I_t + (1-\alpha) B_{t-1}$
  - $\alpha = 0$ → bg sub, no update
  - $\alpha = 1$ → frame differencing
- NOTE: $bg = np.uint8(B_t)$

Mixture of Gaussians

$$P(x_t) = \sum_{i=1}^{K} \omega_{i,t} \eta(x_t, \mu_{i,t}, \Sigma_{i,t})$$

- $\omega_{i,t}$ = weight for the current Gaussian
- Select ***K***
- Rank the Gaussians on the basis of
  - Peak amplitude
  - Weight
  - Standard deviation

$$\omega_{k,t} = \alpha M_{k,t} + (1 - \alpha)\omega_{k,t-1}$$

- α is the so-called learning rate
- M is one for the matching model and 0 otherwise

  → if it is not the matching model, the weight is decreased

Exercise

- Go to OpenCV 4 documentation
- https://docs.opencv.org/4.1.2/d6/d00/tutorial_py_root.html
- Check the parameters for the BackgroundSubtractorMOG
- Try to change the number of Gaussians and the history (how much time you want to spend to learn the background model) used and check the results

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- Change the MOG to BackgroundSubtractorMOG2
- Use the method `getBackgroundImage()`; to get the background
- Display the background and observe how it changes over time with different values of the learning rate parameter