Master in Computer Vision Barcelona

Project Module 4 Coordination

Video Surveillance for Road Traffic Monitoring

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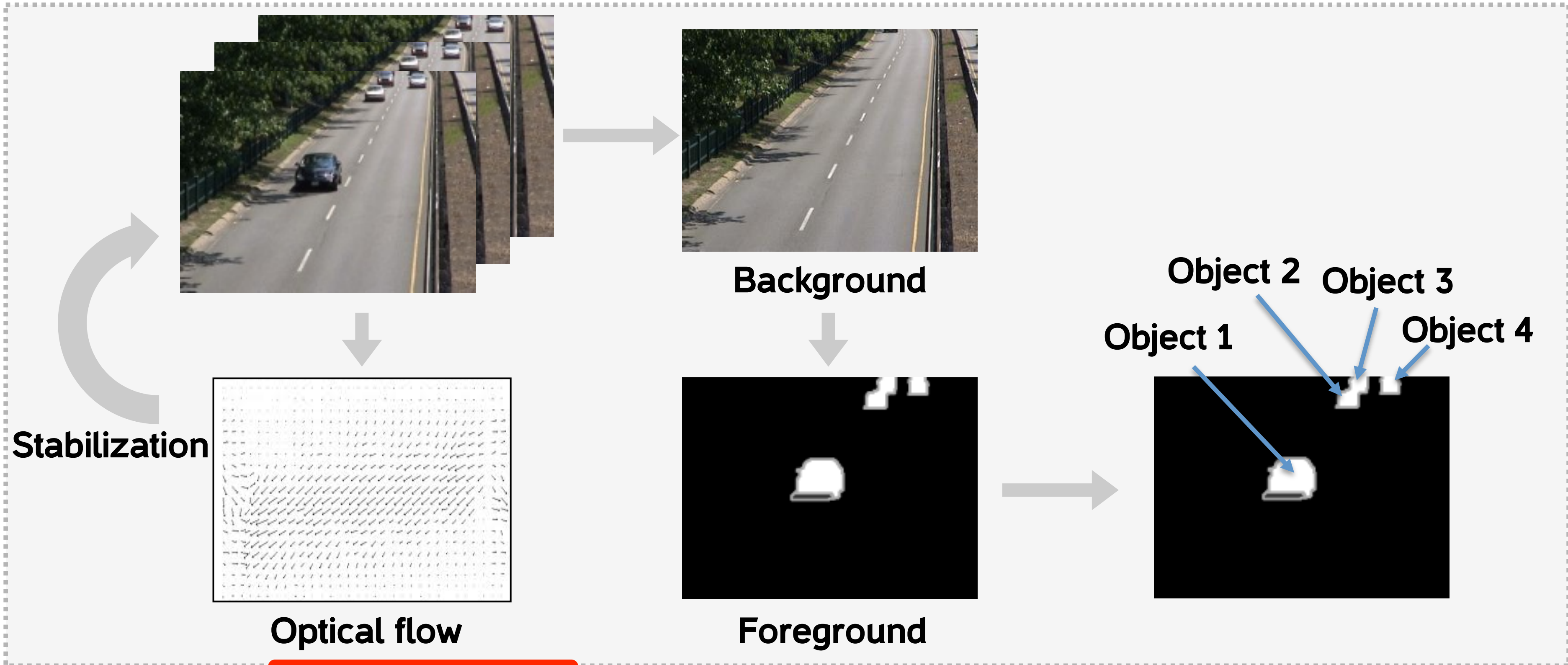
Project Schedule



Week 1	Week 2	Week 3	Week 4	Week 5	Week 6
•Introduction •DB •Evaluation metrics	•Background estimation •Stauffer & Grimson	•Foregroud segmentation •Area filter •Hole filling •Shadow removal	•Optical flow •Video stabilization	•Region tracking •Kalman filter	•Presentation

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Assignments: Week 2

- Background estimation
  - Model the background pixels of a video sequence using a simple statistical model to classify the background / foreground
    - Single Gaussian per pixel
    - Adaptive / Non-adaptive

    The statistical model will be used to preliminary classify foreground
  - Comparison with more complex models (Stauffer and Grimson)

Assignments: Tasks

- Mandatory:
  - Task 1: Gaussian distribution
  - Task 2 & 3: Evaluate results
  - Task 4: Recursive Gaussian modeling
  - Task 5: Evaluate and compare to non-recursive
- Optional:
  - Task 6: Compare with S&G
  - Task 7: Color sequences

Sequences

- HIGHWAY
  - frames 1050 to 1350
  - baseline category
- FALL
  - frames 1460 to 1560
  - dynamic background category
- TRAFFIC
  - frames 950 to 1050
  - camera jitter category

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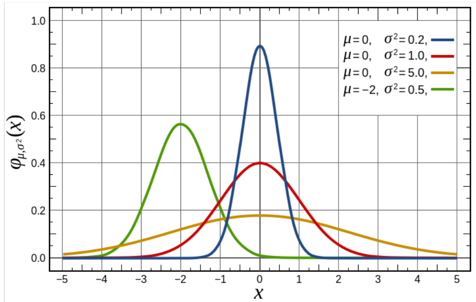
Reminder: metrics

- The groundtruth images contain 5 labels namely
  - 0 : Static
  - 50 : Hard shadow
  - 85 : Outside region of interest
  - 170 : Unknown motion (usually around moving objects, due to semi-transparency and motion blur)
  - 255 : Motion

- We will use:
  - Background: 0, 50
  - Foreground: 255
  - Unknown (not evaluated): 85, 170

Task 1

- 1 Gaussian function to model each background pixel
  - First 50% of the test sequence to model the background
    - Mean and variance of pixels



  - Second 50% to segment the foreground

for all pixels i **do**
    if $|I_i - \mu_i| \geq \alpha \cdot (\sigma_i + 2)$ **then** $\triangleright$ +2 to prevent low values of σ_i
        pixel $\rightarrow$ Foreground
    else
        pixel $\rightarrow$ Background
    end if
end for

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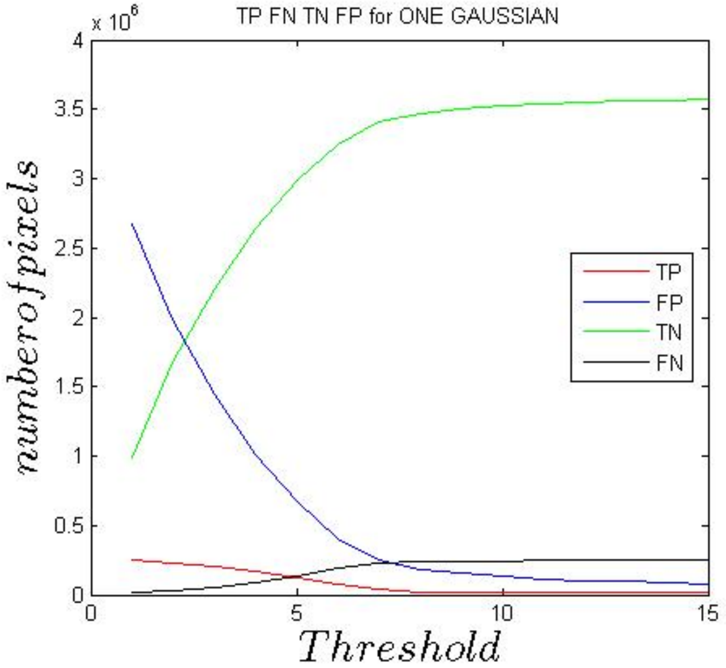
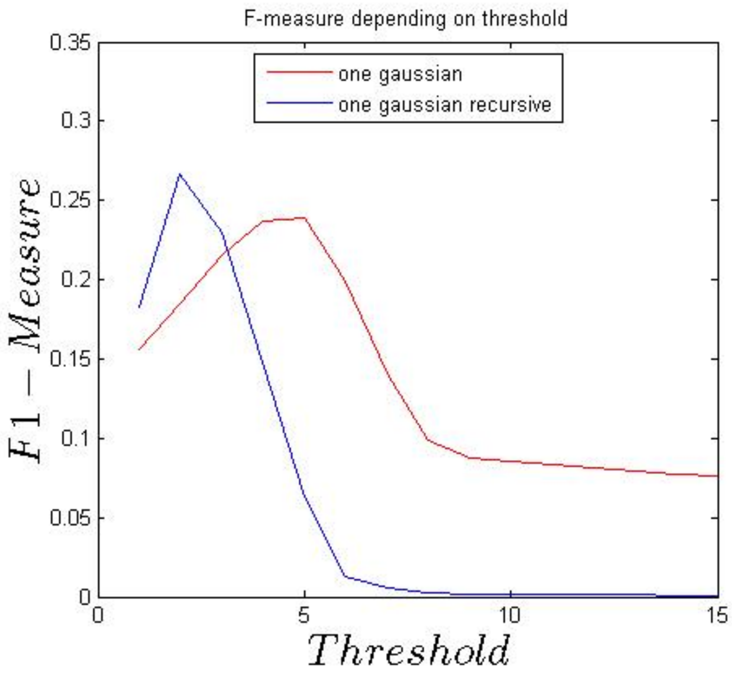
Task 2

- Evaluate Task 1
  - True Positive, True Negative, False Positive, False Negative, Precision, Recall, F1-score vs alpha





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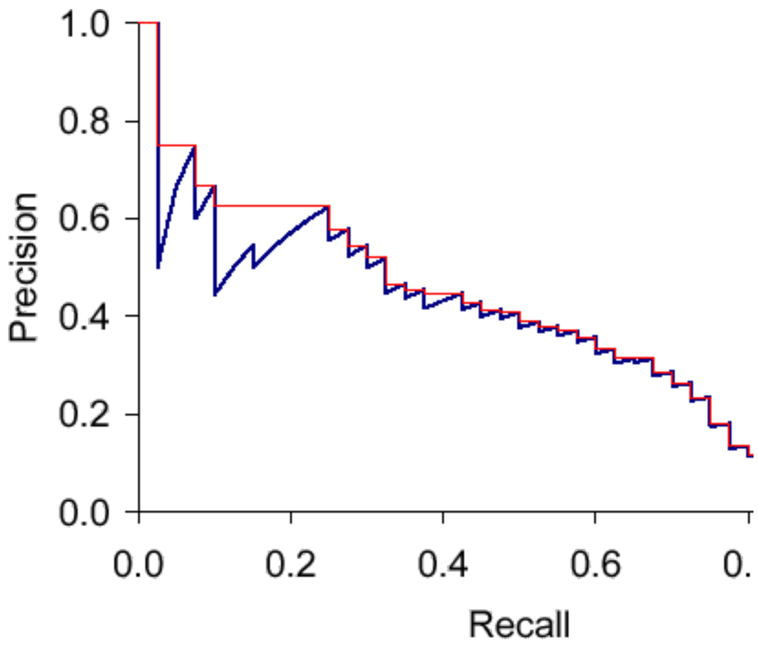
Task 3

- Evaluate Task 1
- Precision vs Recall curve
- Area Under the Curve (AUC)



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Task 4

- Adaptive modeling
  - First 50% frames for training
  - Second 50% left background adapts

$$
\begin{aligned}
&\textbf{if } \text{pixel } i \in \text{Background } \textbf{then} \\
&\qquad \mu_i = \rho \cdot I_i + (1-\rho) \cdot \mu_i \\
&\qquad \sigma_i^2 = \rho \cdot (I_i - \mu_i)^2 + (1-\rho) \cdot \sigma_i^2 \\
&\textbf{end if}
\end{aligned}
$$

  - Best value of α, *p* to maximize F1-score
    - Two methods:
      - Obtain best α non-recursive and then obtain *p* for the recursive cases
      - Optimize them together

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Task 5

- Compare both the adaptive and non-adaptive version and evaluate them for all 3 sequences proposed
  - F1-score

Optional tasks 6

- Compare with Stauffer and Grimson
  - Implementation in Matlab Computer Vision Toolbox (preferred) or provided (StGm.zip)
    - Select the best number of Gaussians (3 to 6)

  - Evaluate precision vs recall to comment which method (single Gaussian programmed by you or S&G) performs better
  - Evaluate the sequences than benefit more of the multiple Gaussians and try to explain why

Optional tasks 7

- Update your implementation to support color sequences
  - Decide color space? RGB vs YUV?
  - Number of Gaussians needed?

Deliverables

- 1 slides per tasks
- Matlab code used for the week assignment

- 14th January
  - Upload to UAB virtual campus presentation + code

Scoring rubric

Grade	Common meaning	Successfully completed tasks
A	Excellent	All mandatory and two optional tasks
B	Very good	All mandatory and one optional task
C	Average	All mandatory tasks
D	Difficulties	All mandatory tasks but one
F	Fail	All mandatory tasks but two or less