Master in Computer Vision Barcelona

Module: M1

Project: Traffic Sign Detection/Recognition

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M1 – Block 1:Tasks feedback

General comments:

- Slides file name: TX-WY
- Add slide numbers!
- Always show results
- Explain approaches briefly
- Explain how parameters are obtained (and provide values)
- Add conclusions

M1 – Block 1:Tasks feedback

Task 1:

- It is useful to collect min, max, mean & stddev for all measures. This will allow to filter out non signal detections
- Reflect the obtained values on slides (some teams did, some did not)

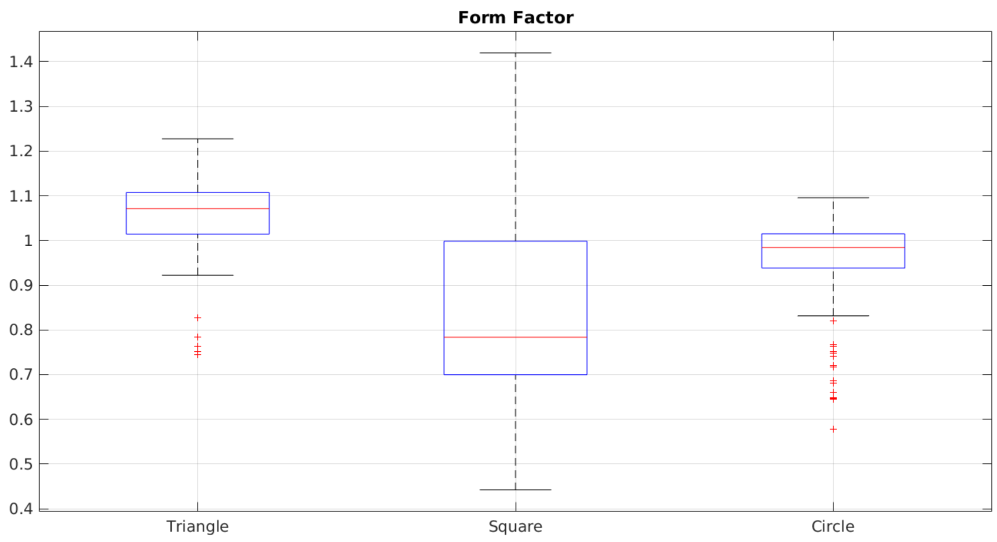
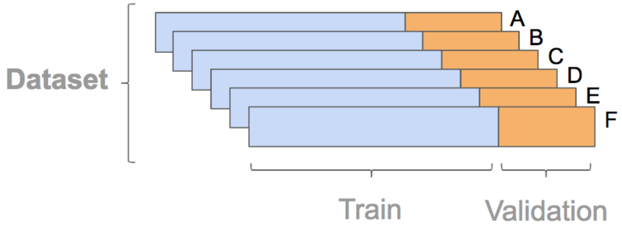


Figure source: Team 1

M1 – Block 1:Tasks feedback

Task 2:

- Most teams balanced train/validation independently on each signal type. ✔



- Team 5 claims to have used also signal size inside each type, but the approach was not clear ✔✔

Figure source: Team 3

M1 – Block 1:Tasks feedback

Task 3 lessons:

- HSV / YCbCr are clear winners among the different teams
- RBG is problematic as illumination will have strong influence on color representation
- Several teams used histograms
- Optimization for F1 may not be the best solution but will do for now. High recall will be more important for next blocks
- Black & white regions detection presents problems. Masks with ‘holes’

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M1 – Block 1:Tasks feedback

Task 4:

- Provide all metrics on the validation set

Task 5:

- Using HSV / Lab or normRGB already gives a good degree of illumination invariance.
- Some groups show images but not numerical results!

M1 – Block 1:Tasks feedback

- **Team1**: T1: Statistical analysis great ☺ but only provided for shape.
  T3: Need explanation of threshold selection
- **Team2**: T1: No numerical results provided!
  T2: Used ff+shape for the split, but not explained!
  T3: Need explanation of threshold selection
  T5: Approach not explained. No results!
- **Team3**: T1: Noticed that ff/fr are discriminative for signal type ☺
  T2: Good visualization ☺
  T3: Combination of blue and red masks in HSV+YCbCr color spaces
  Filtering & Hole filling (Week 2!!)
  Provide segmentation examples ☺
- **Team4**: T2: comments too low level or implementation based (strings in matlab?)
  T3: RGB thresholding. Threshold selection not explained
  T4: Results not too good.
  T5: No results to prove if compensation is useful or not

M1 – Block 1:Tasks feedback

- **Team5**: T1: “Filling ratio sensitive to the light”. Explain
  T2: Several ranges computed, not clear if/how used for the splitting
  T3: Segmentation using K-Means/MS/etc not clear. Explain!
  T4: Recall & F1 not provided
- **Team6**: T1: Size, max, min, avg, stddev not computed!
  T3: HSV, no info on thresholds
  T4: Recall & F1 not provided
  T5: No results nor conclussions
- **Team7**: T1: No results on slides!
  T3: Pixel-based criterion, needs better explanation. T1, T2, T3??
  T4: No comments! No conclusions.
- **Team8**: T1:Unnecessary detail in comments (implementation)
  No numerical results (statistics)
  T2: Problems with images with more than one signal type not solved
  T3: RGB, gaussian model. Needs more explanation (threshold selection)
  T4: Low recall.

M1 – Block 1: Results

Task 4: Results on the test set

	Precision	Recall	F1	time/frame (s)
Team 1	0.03	0.60	0.05	
Team 2	0.03	0.62	0.06	
Team 3	**0.56**	**0.69**	**0.62**	
Team 4	Training set!			
Team 5	0.11	0.49	0.18	
Team 6	0.33	0.48	0.39	
Team 7	0.25	0.16	0.19	
Team 8	0.15	0.41	0.22	

M1 – Block 1: Results

Task 4: Results on the validation set

	Precision	Recall	F1	time/frame (s)
Team 1	0.04	0.52	0.07	??
Team 2	0.03	0.56	0.45	0.45
Team 3	0.42	0.61	0.45	2.93
Team 4	0.0033	0.21		??
Team 5	0.25	??	??	0.50
Team 6	0.31	??	??	??
Team 7	0.29	0.33	0.30	??
Team 8	0.59	0.17	0.27	1.10

M1 – Block 2: Implementation of Morphological operators

Goal: **Understand and apply morphological operators in Image Processing**

Task 1: Implement morphological operators Erosion/Dilation. Compose new operators from Dilation/Erosion: Opening, Closing, TopHat and TopHat dual

Task 2: Measure the computational efficiency of your programed operators Erosion/Dilation

Task 3: **Use operators to improve results in sign detection**

Task 4: Apply histogram back-projection to perform color segmentation

M1 – Block 2: Implementation of Morphological operators

Task 1: implement morphological operators

Looking for inspiration for the specification of the implementation of my “dilate” matlab function:

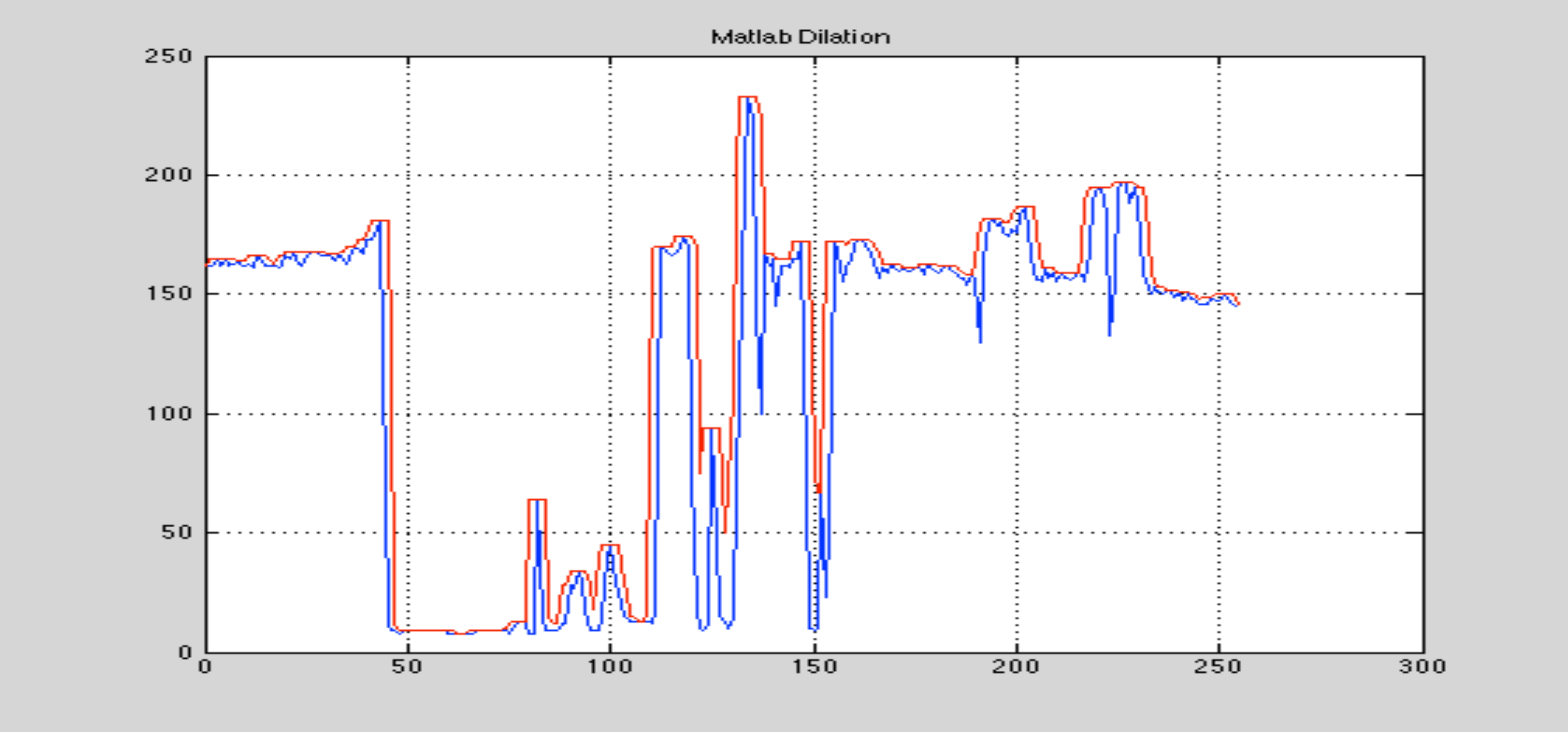
```
> help imdilate
imdilate Dilate image.
  IM2 = imdilate(IM,SE) dilates the grayscale, binary, or
  packed binary image IM, returning the dilated image, IM2.
  SE is a structuring element object, or array of
  structuring element objects, returned by the STREL
  function.


Example:
   se = strel('square', 5); % 5 points SE
   Y  = imdilate(Signal, se);
   plot(x, Signal, ’b’, x, y, ’r’); grid;
```

M1 – Block 2: Implementation of Morphological operators

Task 1: Implement morphological operators

Native Matlab Example:

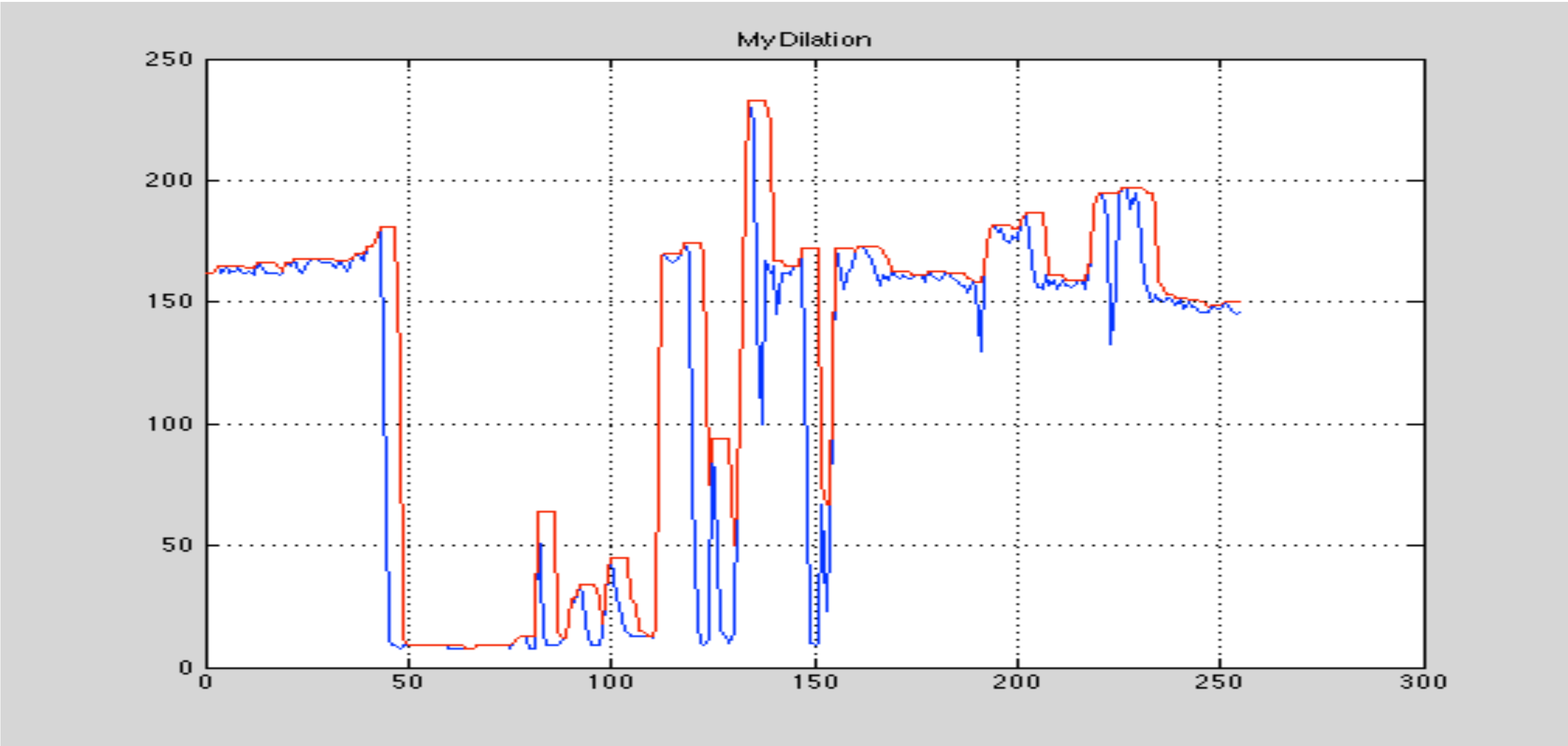
```
se = strel('square', 5); % 5 points SE definition
Y  = imdilate(Signal, se);
```



M1 – Block 2: Implementation of Morphological operators

Task 1: Implement morphological operators

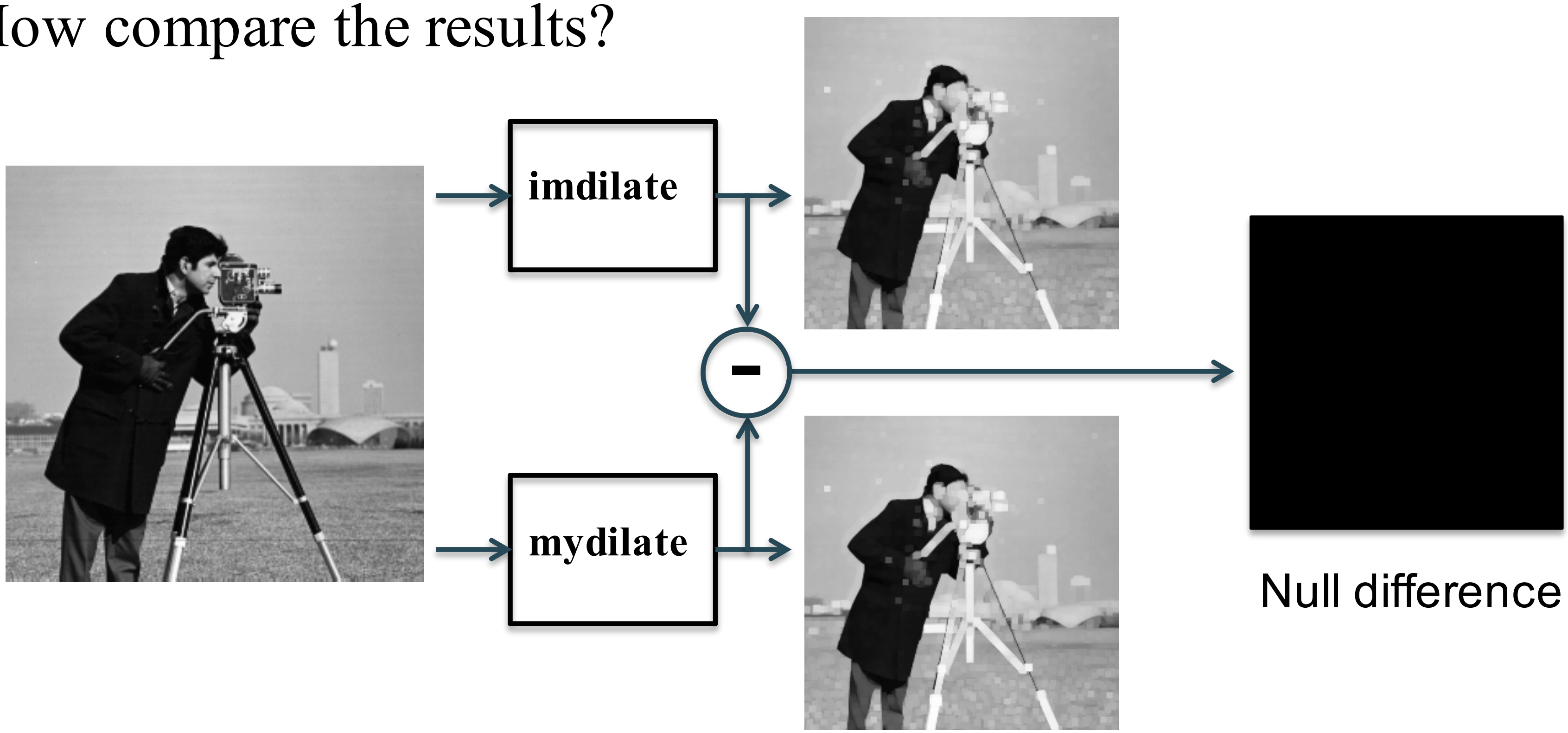
```
Example with mydilate function:
    se =[1,1,1,1,1];  % 5 points structuring element
    y  = mydilate(Signal, se);
```



M1 – Block 2: Implementation of Morphological operators

Task 2: Measure the computational efficiency of your programed operators

How compare the results?



https://www.math.ust.hk/~masyleung/Teaching/CAS/MATLAB/image/target2.html

M1 – Block 2: Implementation of Morphological operators

Task 2: Measure the computational efficiency of your programed operators

```
tic
I2 = imdilate(I,se);
Total_Time      = toc;
```

Comparing computational efficiency	Total Time
Imdilate	8.760 ms
mydilate	19.04 ms
Efficiency % (100*my/im)	**217%**
imerode	7.760 ms
myerode	13.855 ms
Efficiency % (100*my/im)	**178.55%**

M1 – Block 2: Implementation of Morphological operators

Task 3: Use morphological operators to improve results on color segmentation

Tips: Noise filtering, hole filling [matlab: imfill()], object separation, etc.

M1 – Block 2: Implementation of Morphological operators

Task 4: Segmentation using histogram back-projection[1]

- Divide the signals into groups according to color
- For each group, compute a histogram using all signals of this group
- For all the pixels in the target image, use this histogram as a look-up table to decide the degree of similarity between the pixel's color and the signal's color.

[1]Indexing via color histograms", Swain, Michael J. , Third international conference on computer vision,1990.

M1 – Block 2: Implementation of Morphological operators

Task 4: Segmentation using histogram back-projection

- Divide the signals into groups according to color:
  - G1: A,B,C (Red, White, Black)

  - G2: D, F (Blue, White, black)

  - G3: E (Red, Blue)

M1 – Block 2: Implementation of Morphological operators

Task 4: Segmentation using histogram back-projection

- Compute color histogram for each group
  - Prefer color histograms instead of single channel histograms (2D or 3D histograms)
  - Using 2 channels from perceptual color spaces helps with luminance invariance
  - Number of bins is crucial to avoid histogram sparsity
  - 3D histograms are problematic as the number of bins grows exponentially → sparsity

M1 – Block 2: Implementation of Morphological operators

Task 4: Segmentation using histogram back-projection

- Histogram back-projection:
  - For each pixel in target image, use it's color to look-up at the normalized histogram to estimate the probability of the pixel belonging to this signal type.
  - Use a threshold on the probabilities to generate a mask.

- Perform the previous operation for all the 3 groups and combine masks
- Try also the back-projection algorithm in[1] (normalization using image histogram & smoothing)

[1]Indexing via color histograms", Swain, Michael J. , Third international conference on computer vision,1990.

M1 – Project: Homework Block 2

Evaluation

	Precision	Accuracy	Recall	F1-mesure	TP	FP	FN	Time per frame
Method 1								
Method 2								
Method 3								

Note: Deliver masks to:

/home/ihcv0X/m1-results/week1/test/**method1**/*.png

/home/ihcv0X/m1-results/week1/test/**method2**/*.png

…

Submit progress slides + code + masks
Deadline: 15/10/2017 20:00