

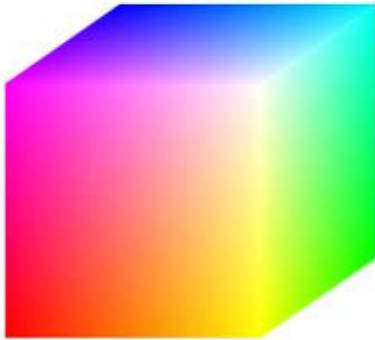
# DETECCCTION AND RECOGNITION OF TRAFFIC SIGNS

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GÓMEZ BRUBALLA, RAÚL

B1/B2

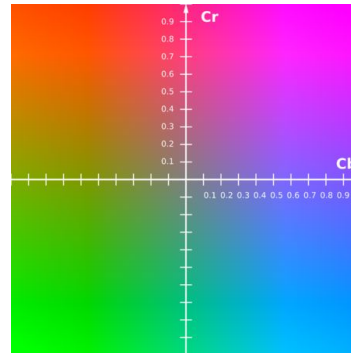
# 1. EVALUATING COLOR SPACE

**RGB**



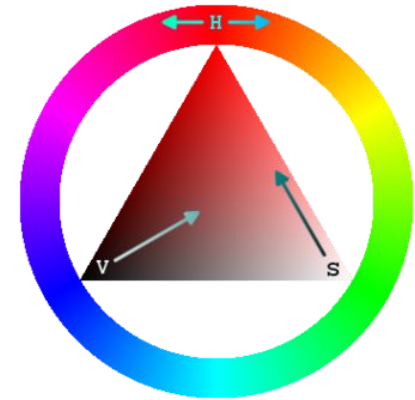
- Hue information in three components [0,255]

**YCbCr**



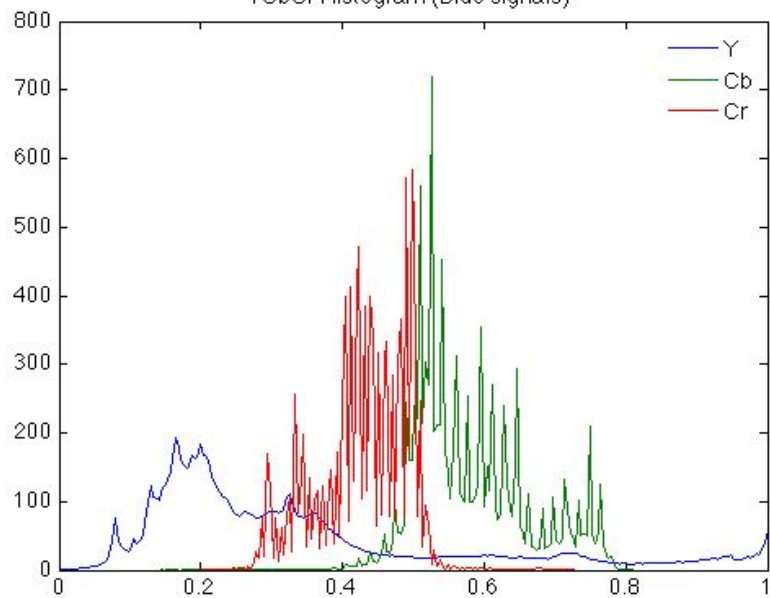
- Separates luminance
- Hue information in 2 components [-127,127]

**HSV**

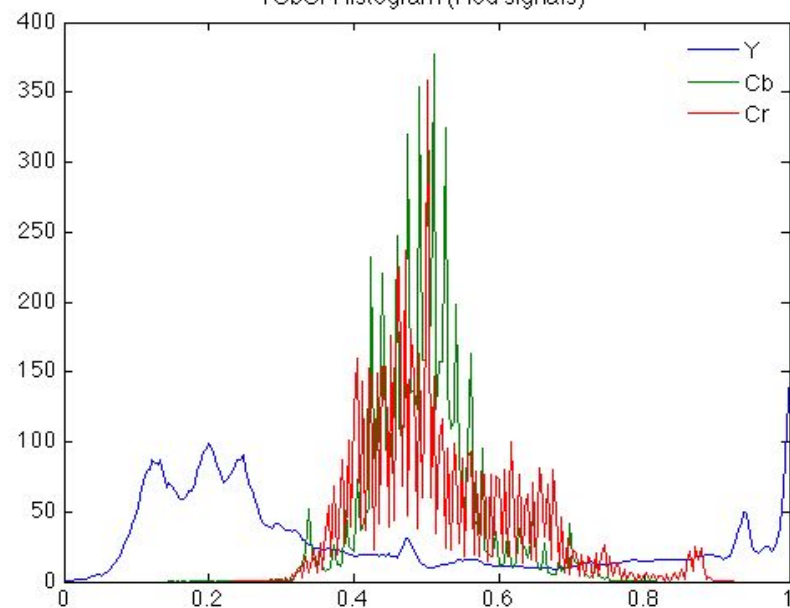


- Separates luminance
- Separates saturation
- Hue information in one component [0°,360°]

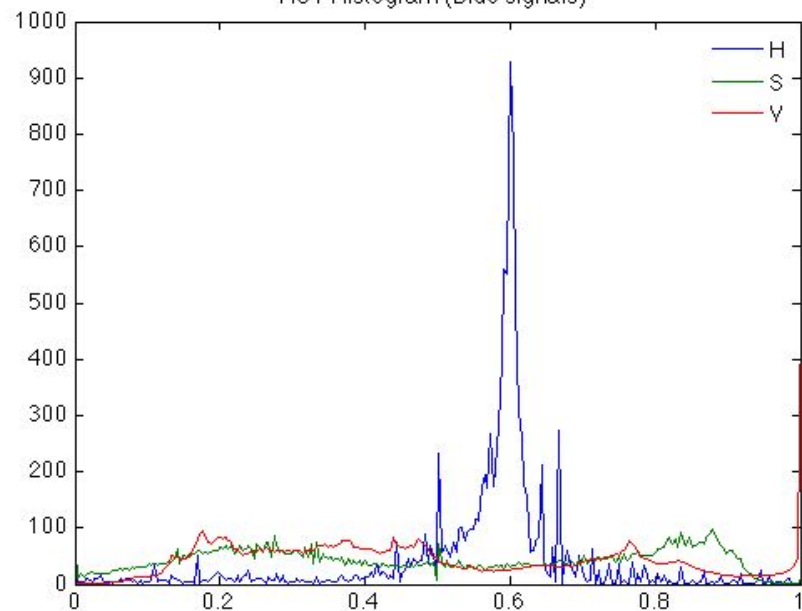
YCbCr Histogram (Blue signals)



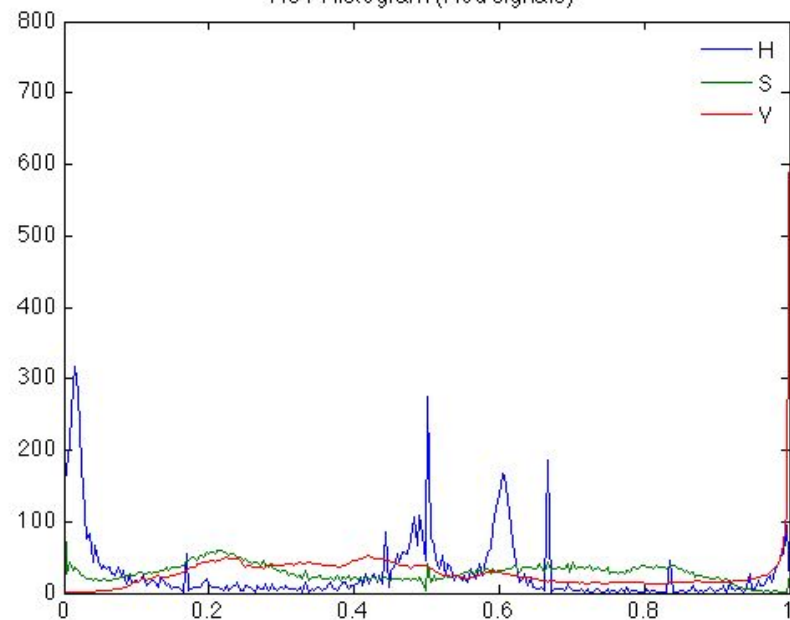
YCbCr Histogram (Red signals)



HSV Histogram (Blue signals)



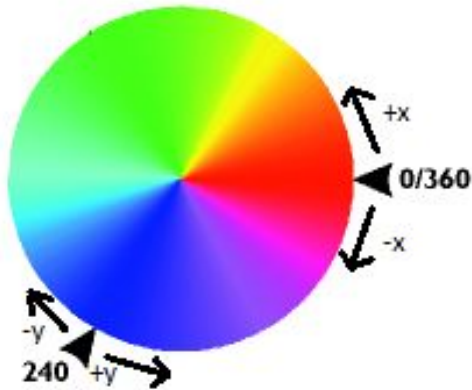
HSV Histogram (Red signals)



# 1. EVALUATING COLOR SPACE

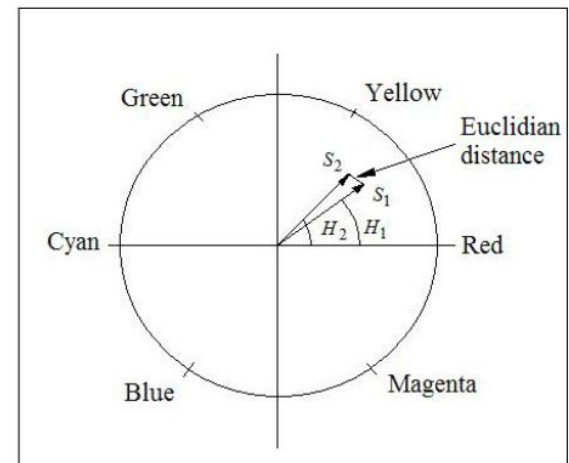
## Method 1:

- Select the signal most common hue and put a threshold of accepted hue variance.
- Train the classifier to select the best variance for each signal color (red and blue).



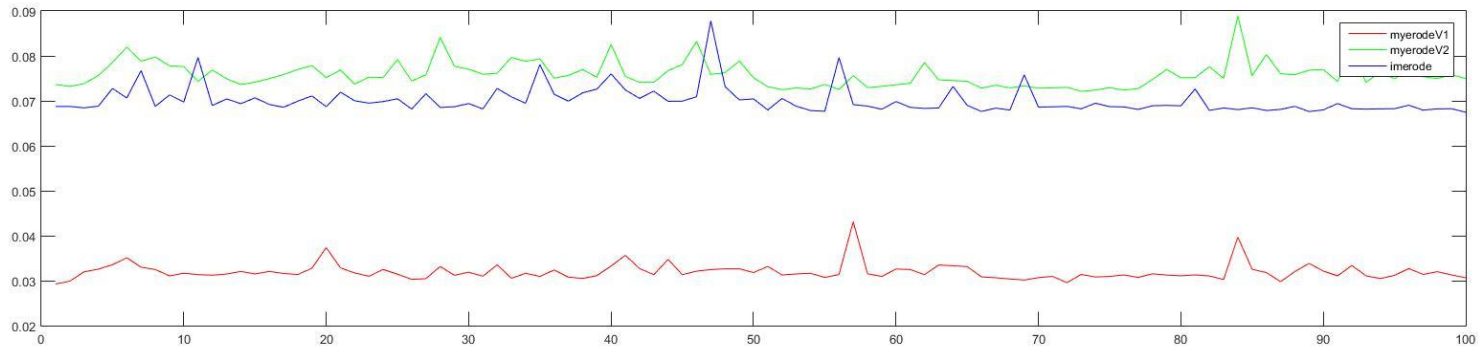
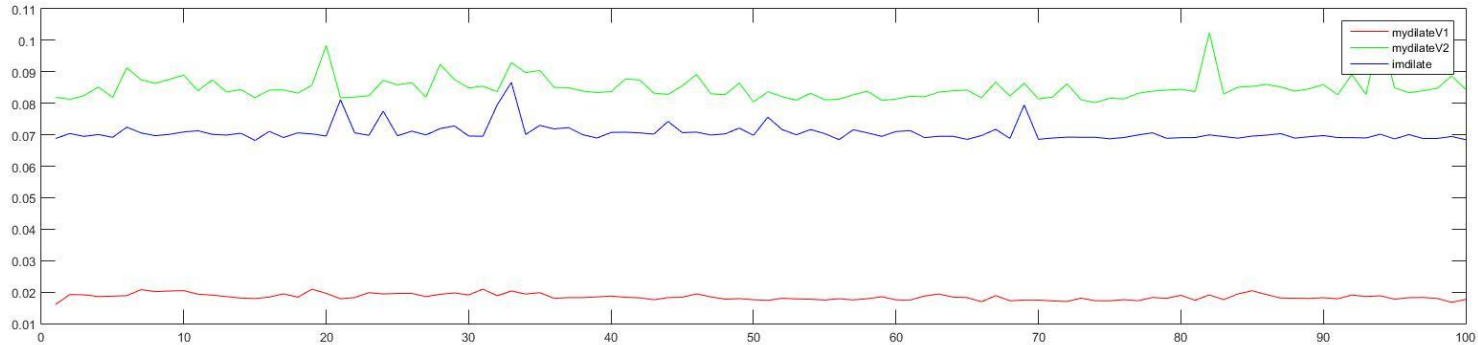
## Method 2\*:

- Compute the euclidian distance between a reference color and the current pixel color.
- The mean luminance of the image defines a threshold between the two colors.
- Train the classifier to adjust the reference colors, starting from the signal most common hues.



\*Method extracted from the paper: "Color detection and segmentation for road and traffic signs" by Hasan Fleyeh.

## 2. EVALUATING MORPHOLOGICAL OPERATORS



2 versions:

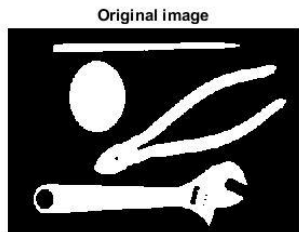
→ **v1:** using 'xcorr2()', 'xconv2()'

→ **v2:** using 'ordfilt2()'

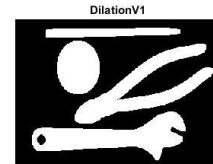
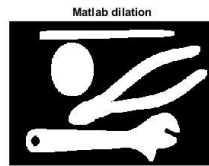
\*efficiency % ( $100 \cdot \text{im}/\text{my}$ )

Efficiency*	Dilation	Erosion
<b>V1</b>	382.4991 %	219.2976%
<b>V2</b>	120.2001%	108.2080 %

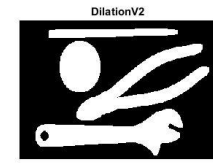
## 2. EVALUATING MORPHOLOGICAL OPERATORS



Dilation

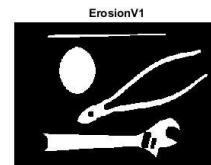
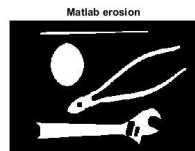


V1

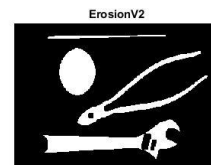


V2

Erosion

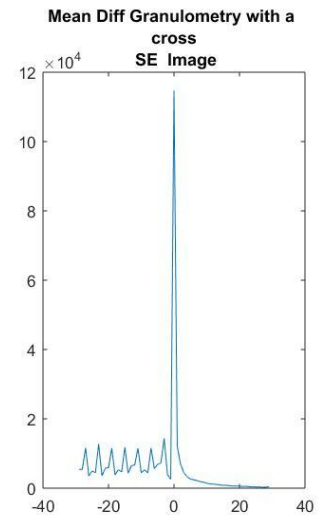
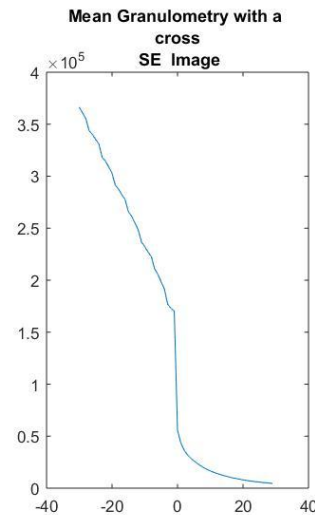
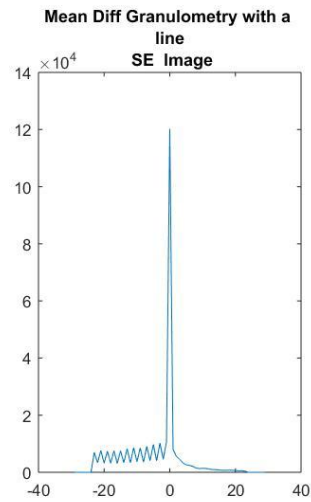
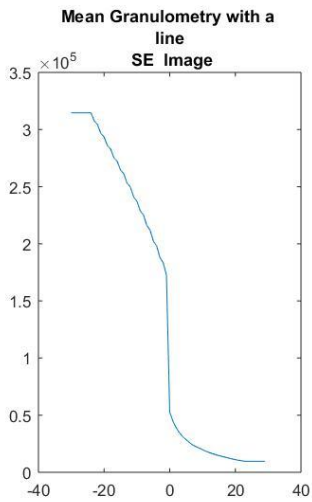
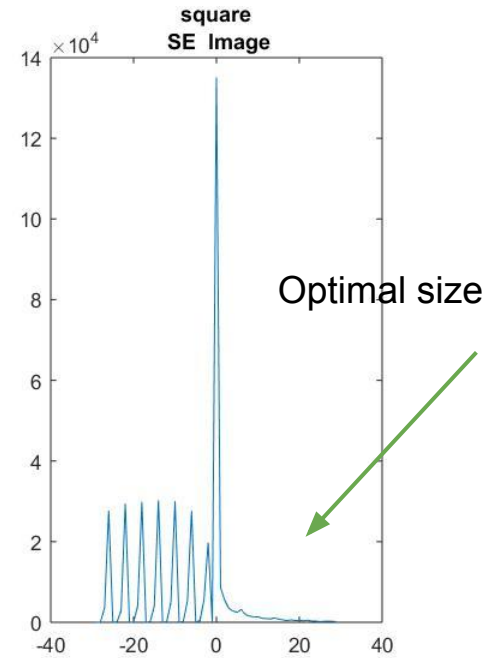
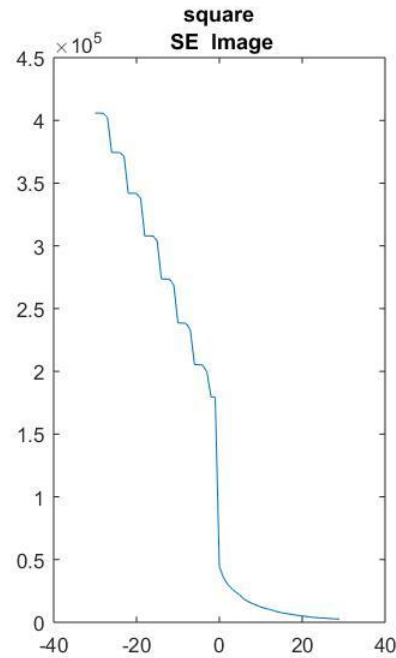
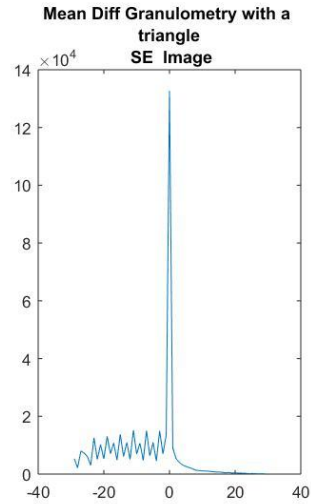
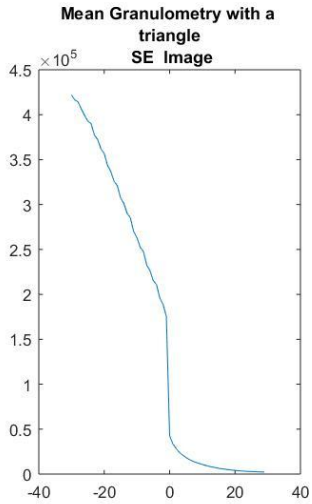


V1



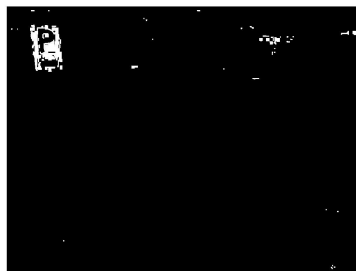
V2

# 3. GRANULOMETRY

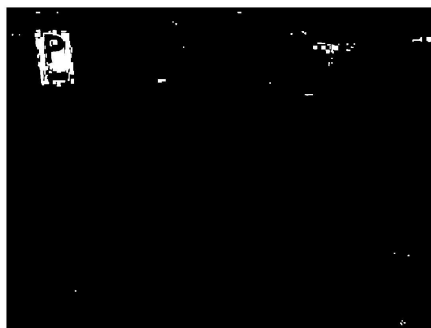


# 4. EVALUATING MORPHOLOGICAL METHOD

**Method 1**  
Opening



Filling holes  
method



**Method 2**  
Reconstruction



Marker



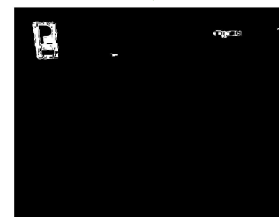
Filling holes method



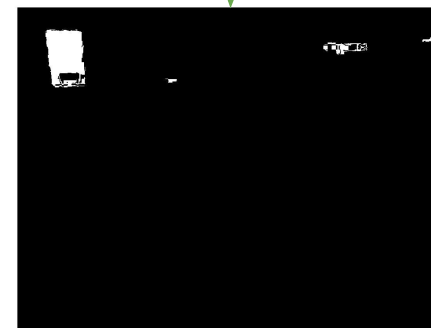
**Method 3**  
TopHat  
+  
Reconstruction



Marker

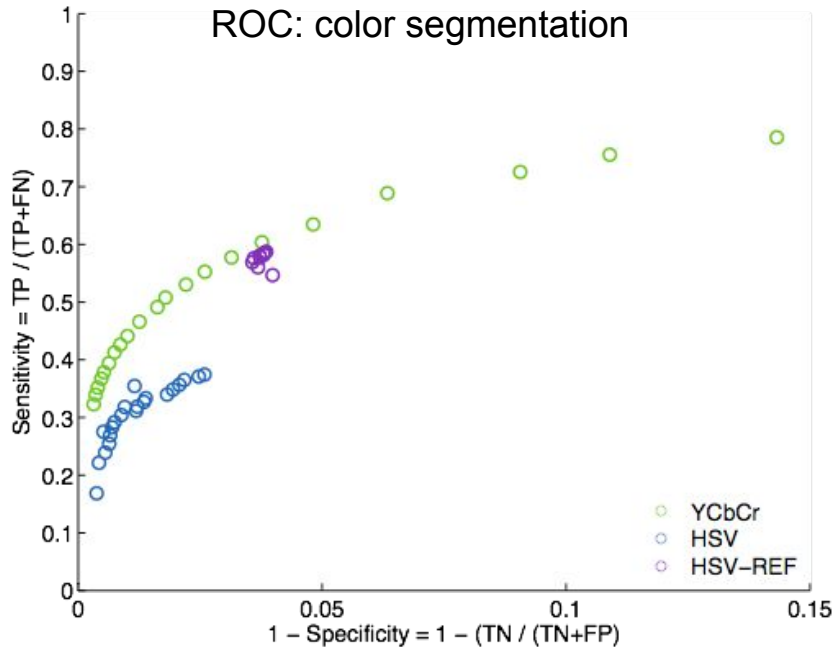


Filling holes method





# 5. RESULTS COLOR SEGMENTATION



## YCbCr

Cb component range =  $0.5 \mp 0.037$

Cr component range =  $0.5 \mp 0.037$

## HSV

Red colors

H component range =  $5.652^\circ \mp 9^\circ$

Blue colors

H component range =  $216^\circ \mp 9^\circ$

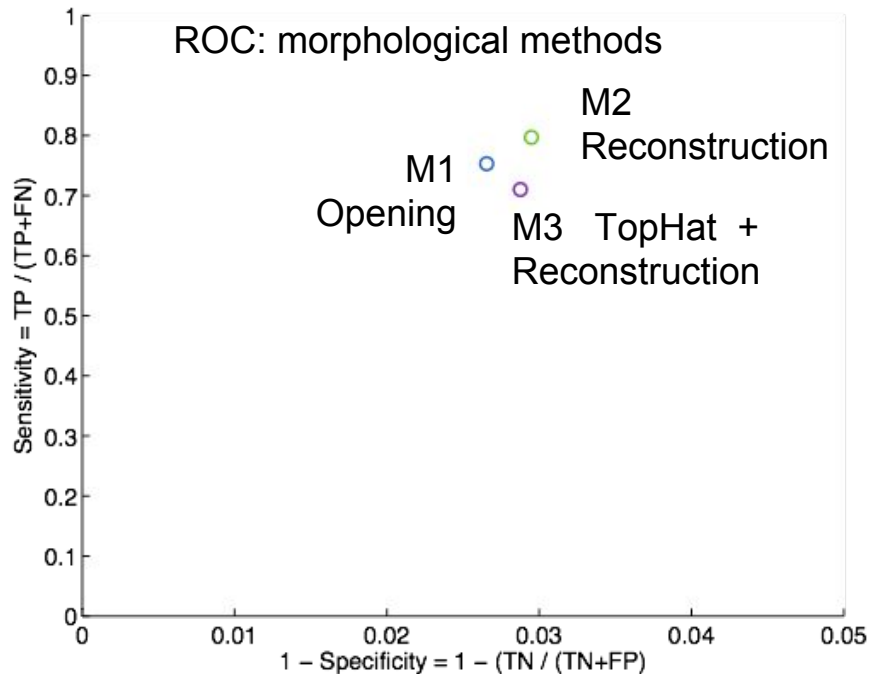
## HSV-REF

Red color reference H =  $0^\circ$  S = 0.9

Blue color reference H =  $219^\circ$  S = 0.9

	Precision	Accuracy	Recall	F1-measure	TP	FP	FN
<b>YCbCr</b>	0.0616	0.9671	0.5774	0.1113	1804712	27501796	1320873
<b>HSV</b>	0.0989	0.9862	0.3547	0.1547	1108696	10096720	2016889
<b>HSV-REF</b>	0.0594	0.9657	0.5818	0.1078	1818440	28802423	1307145

# 5. RESULTS MORPHOLOGICAL METHODS



## M1

- + Opening with a square 3x3 SE
- + Filling holes

## M2

- + Reconstruction by erosion with a square 7x7 SE
- + Filling holes

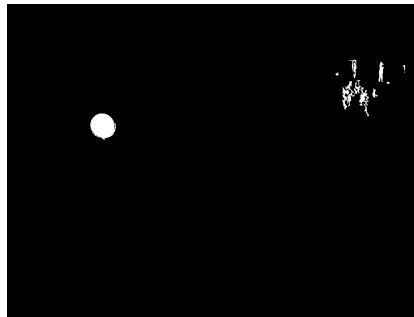
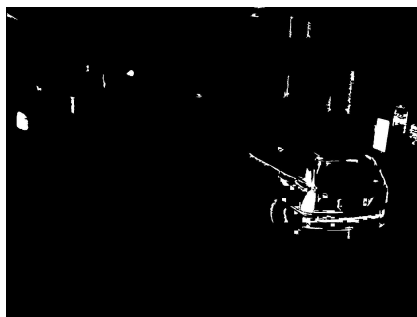
## M3

- + TopHat with a square 14x14 SE
- + Reconstruction by erosion with a square 7x7 SE
- + Filling holes

	Precision	Accuracy	Recall	F1-measure	TP	FP	FN
<b>M1</b>	0.0881	0.9699	0.7968	0.1587	2490585	22772149	635000
<b>M2</b>	0.0921	0.9727	0.7536	0.1641	2353481	23209749	772104
<b>M3</b>	0.0811	0.9703	0.9712	0.1456	2219487	25147302	906098

# 5. CONCLUSIONS

## TEST DATASET



	Precision	Accuracy	Recall	F1-measure	TP	FP	FN
Test DB	0.108	0.9767	0.8643	0.1078	795621	6571509	124879