CMSC426: Project 3
Rotobrush: Segmenting deformable objects in a video

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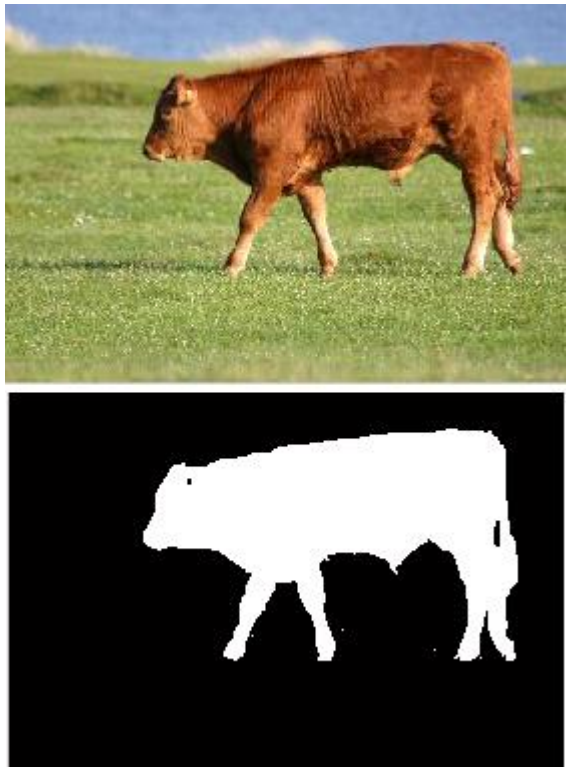
Rotobrush: **Segmenting** deformable objects in a video

What is segmentation?

- Given a point/pixel $x_{i,j}$ in the image
- $x \in$ object 1 or 2 or …….
- $x \in \mathcal{F}\ or\ \mathcal{B}$



Why do we need segmentation?

- Medical Imaging
- Face Detection
- Pedestrian Detection
- Traffic sign detection
- For recognition tasks
- Video Surveillance
- Action localization
- And much, much more…

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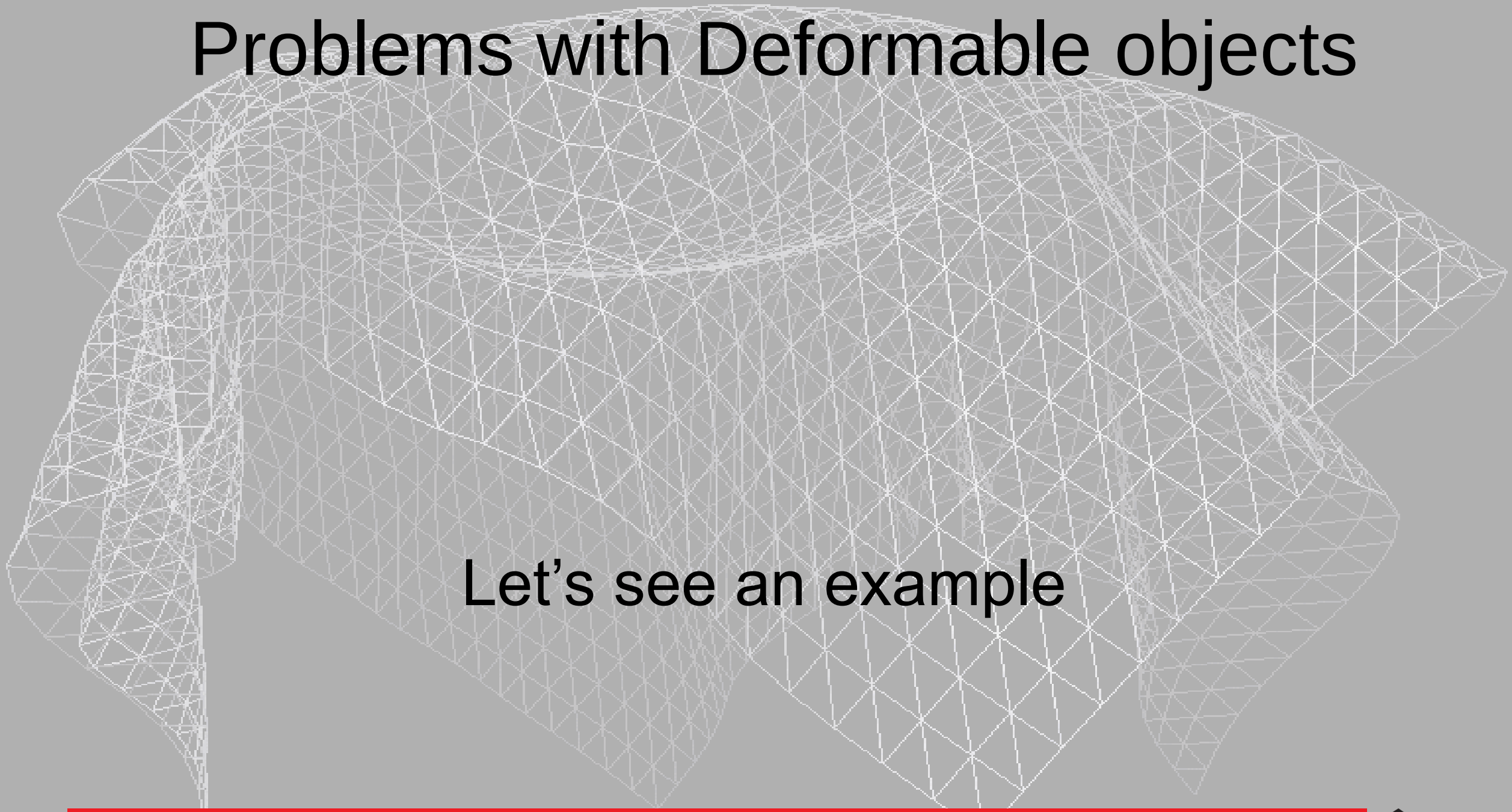
Rotobrush: Segmenting **deformable objects** in a video

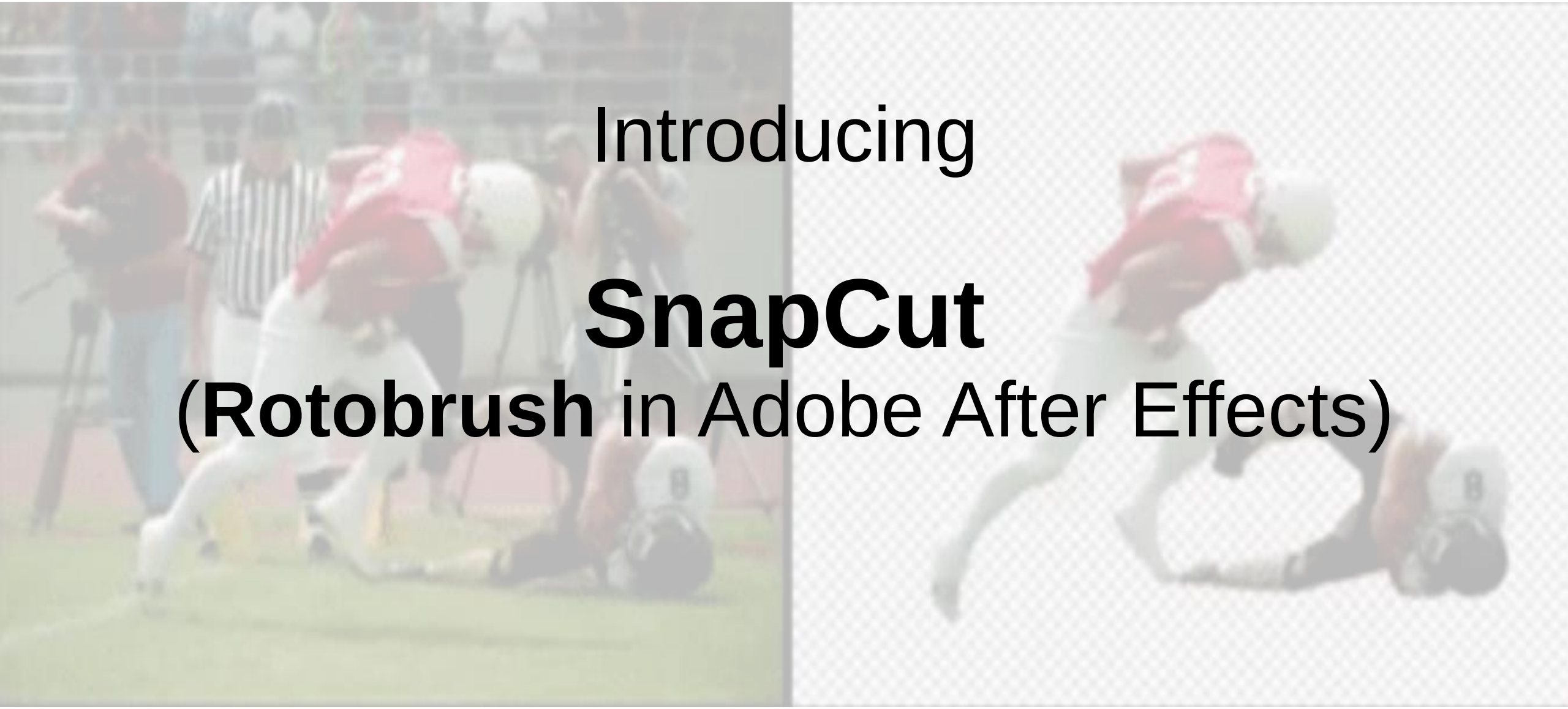
Problems with Deformable objects



Let’s see an example





Introducing

SnapCut

(**Rotobrush** in Adobe After Effects)

Segmenting the object of interest in the first frame

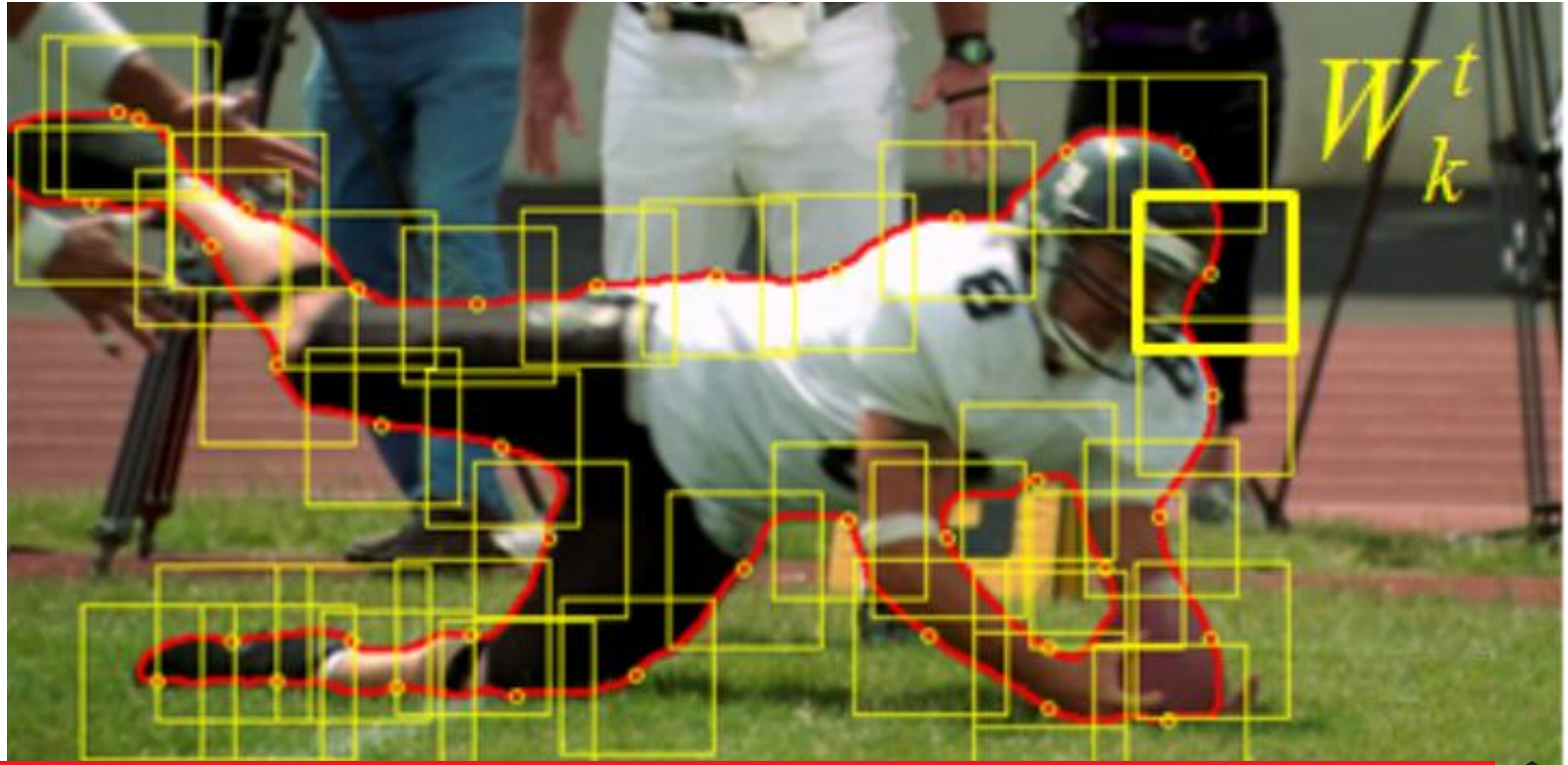
Let's call it foreground or $\mathcal{F}$ for ease.

Rest everything is background or $\mathcal{B}$

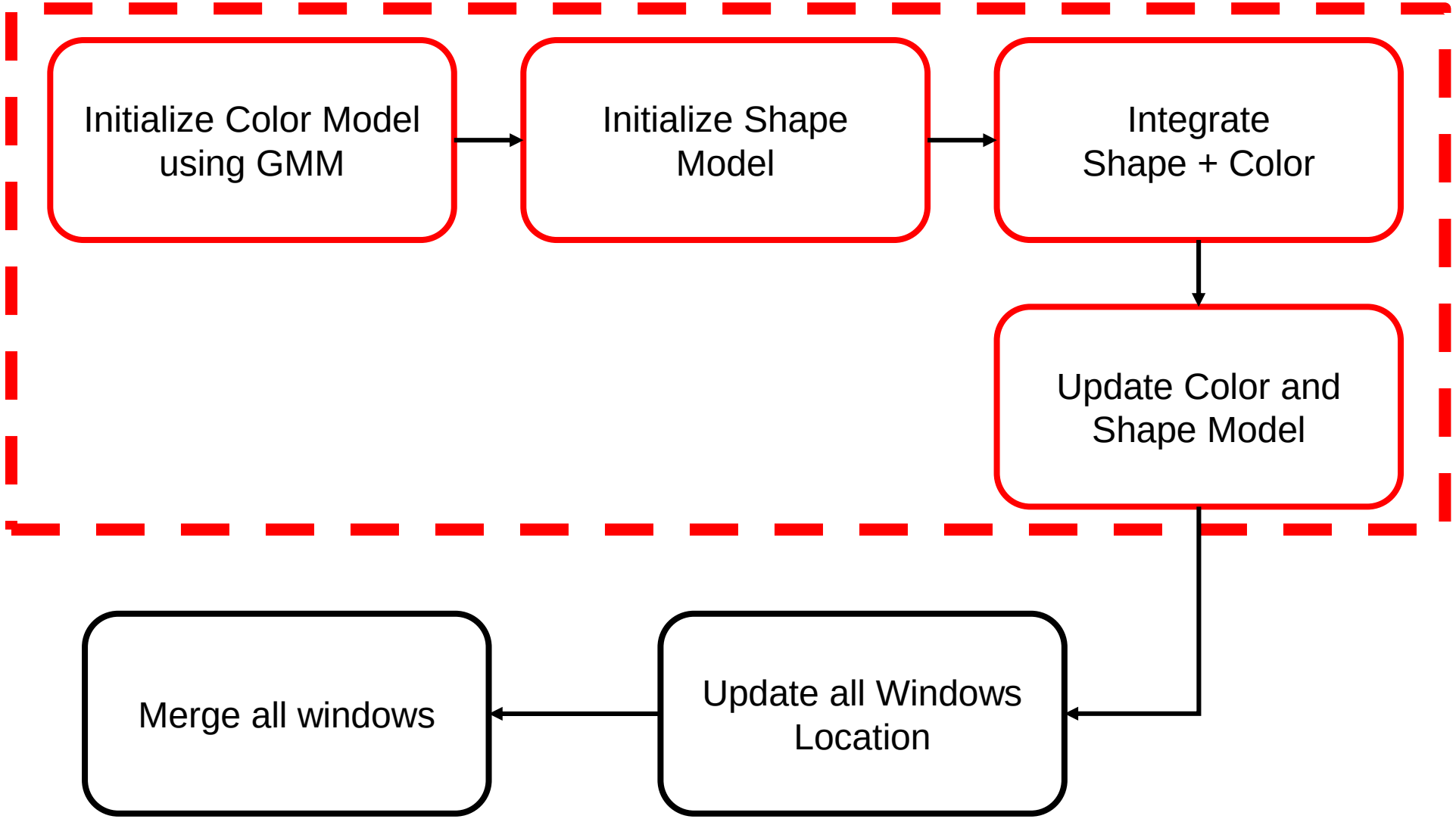
Use 'roipoly' in MATLAB.

Create Local Classifiers

Create Local Windows



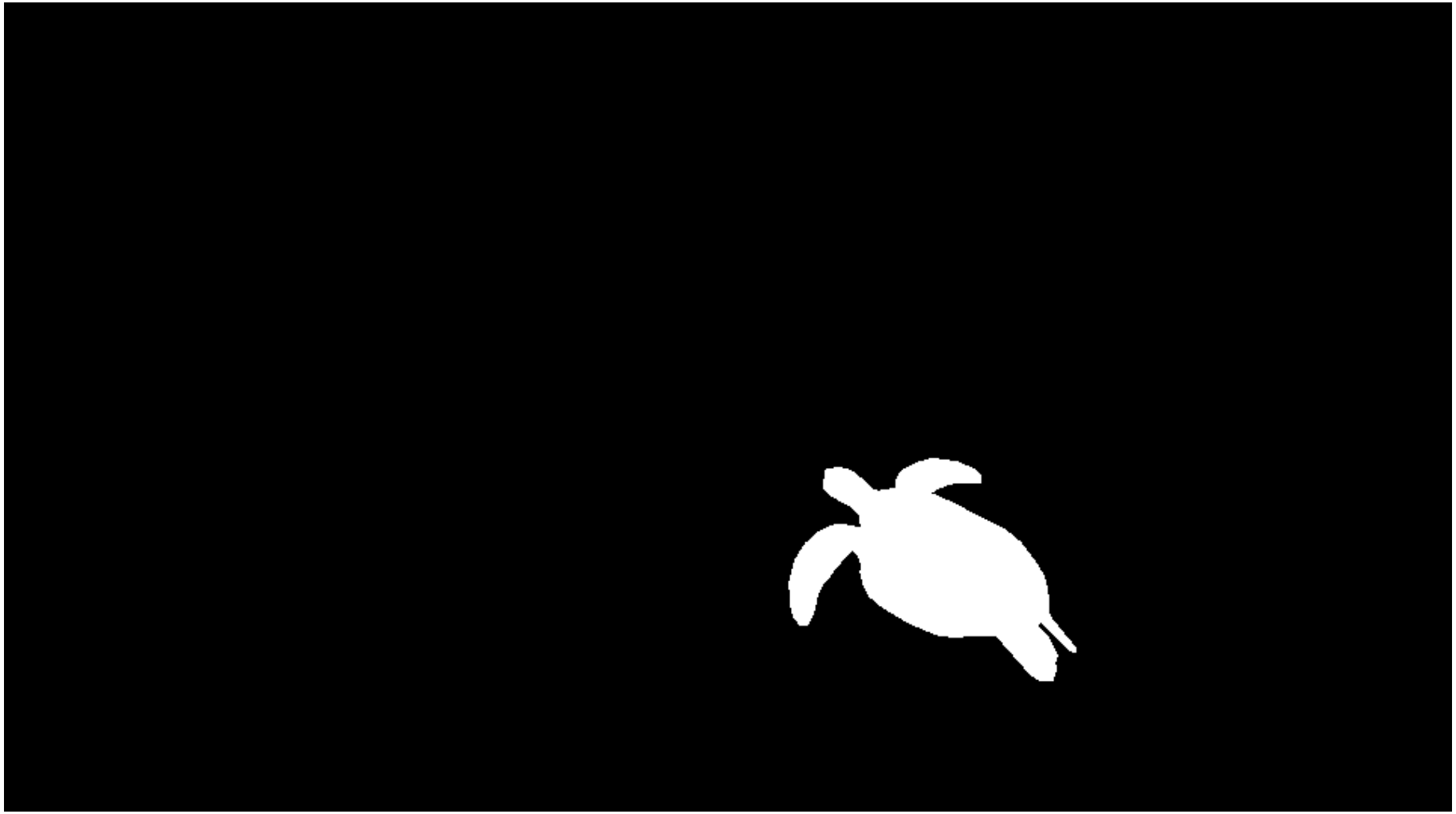
For each local Window



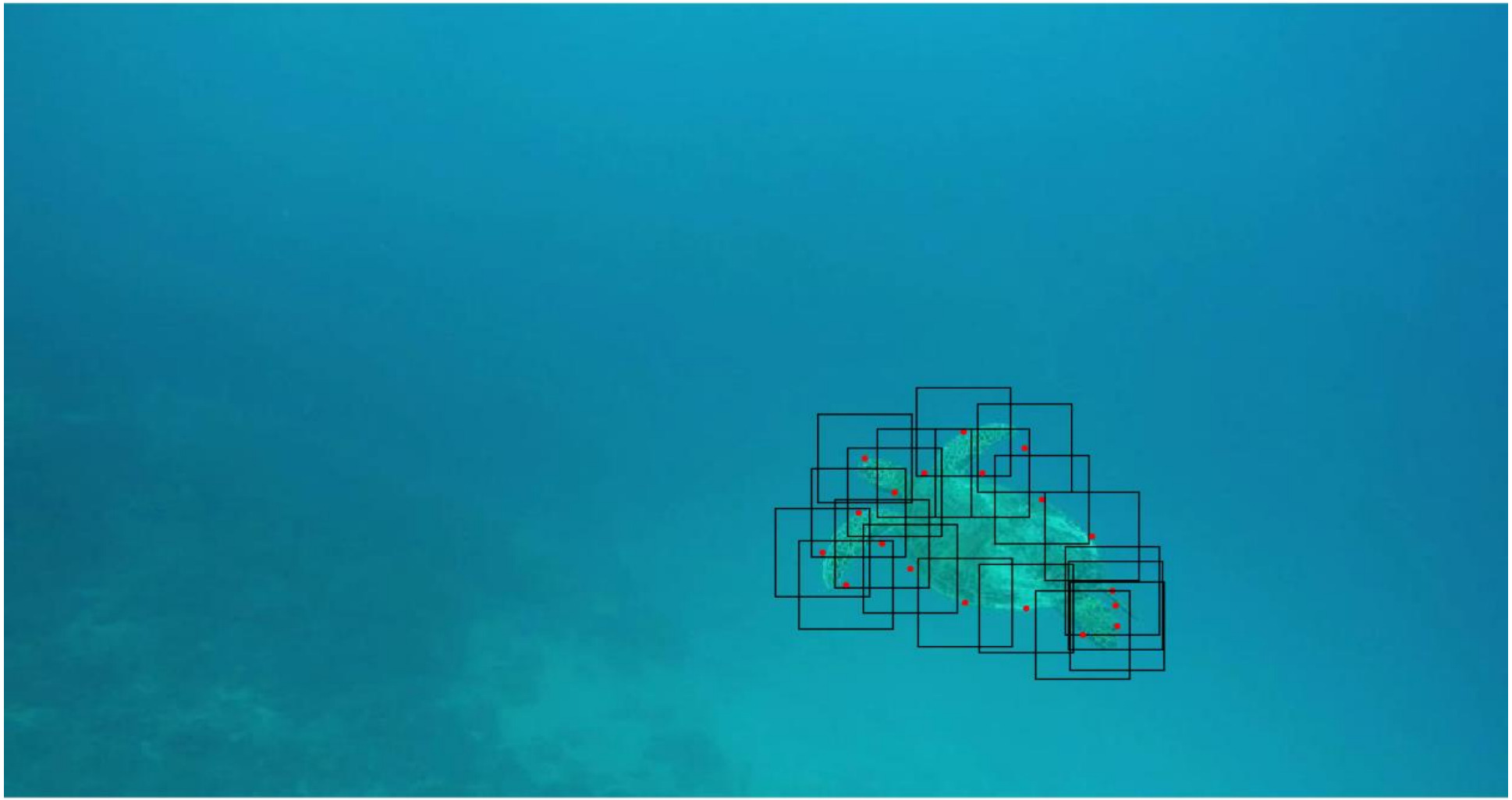
Let’s dig deep

Input

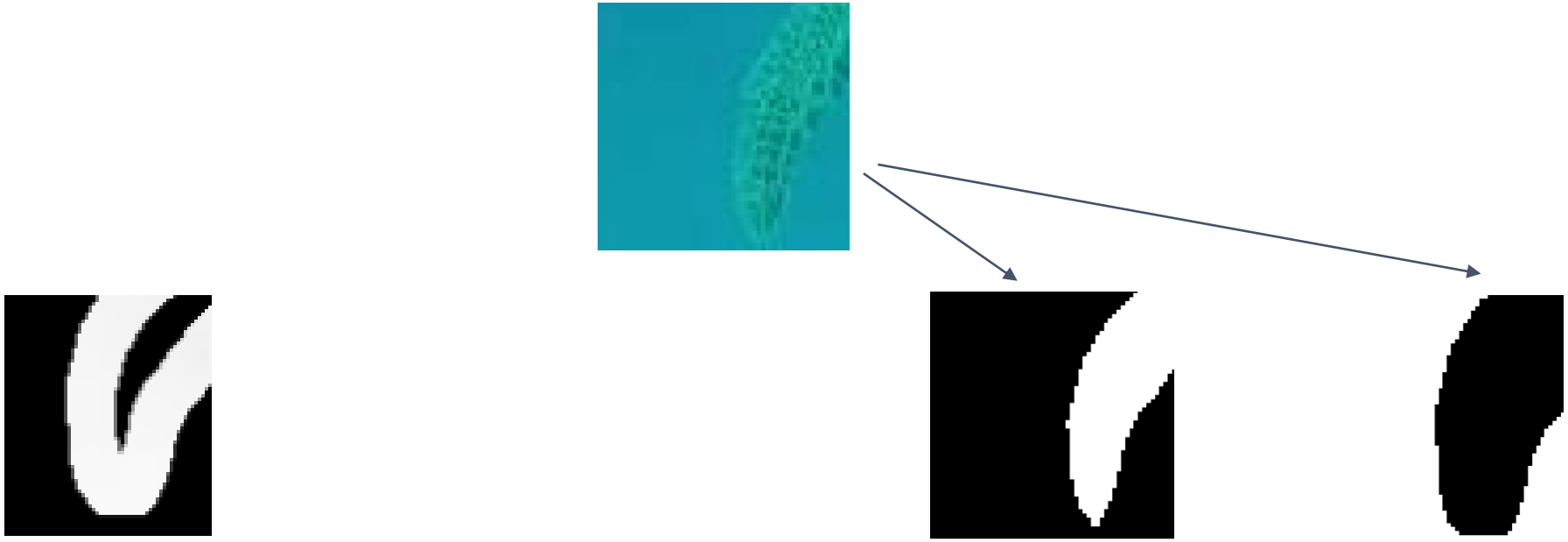
Create Mask



Local Window (initLocalWindows.m)

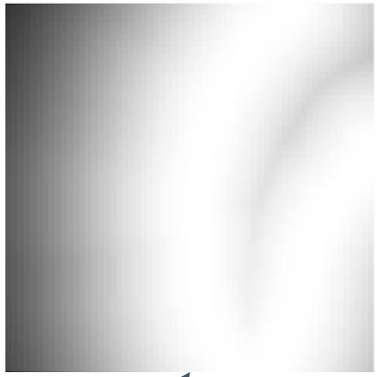


Color model (initColorModels.m)



$$p_c(x) = p_c(x|\mathcal{F}) \; / \; (p_c(x|\mathcal{F}) + p_c(x|\mathcal{B}))$$

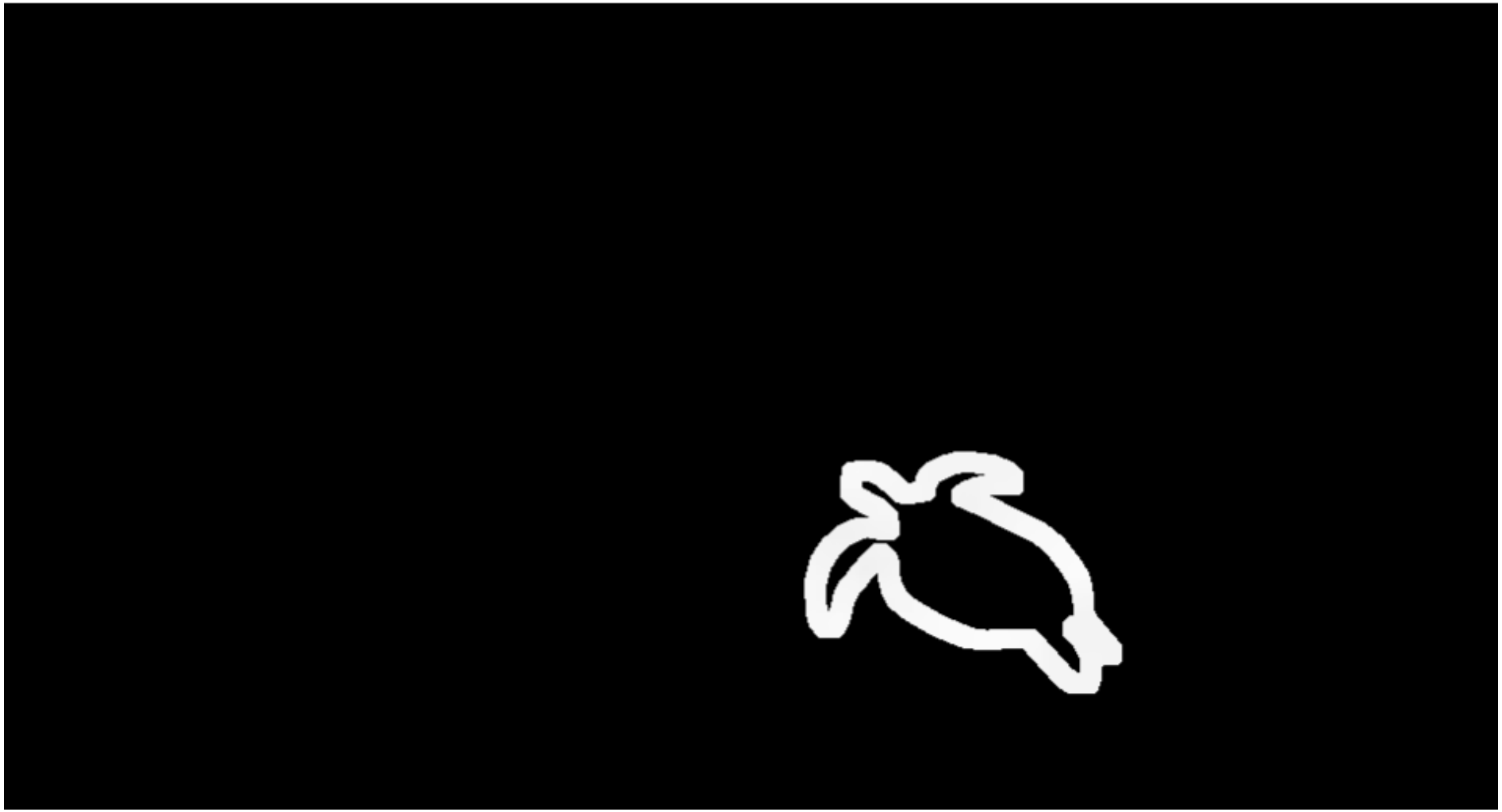
Color model (initColorModels.m)



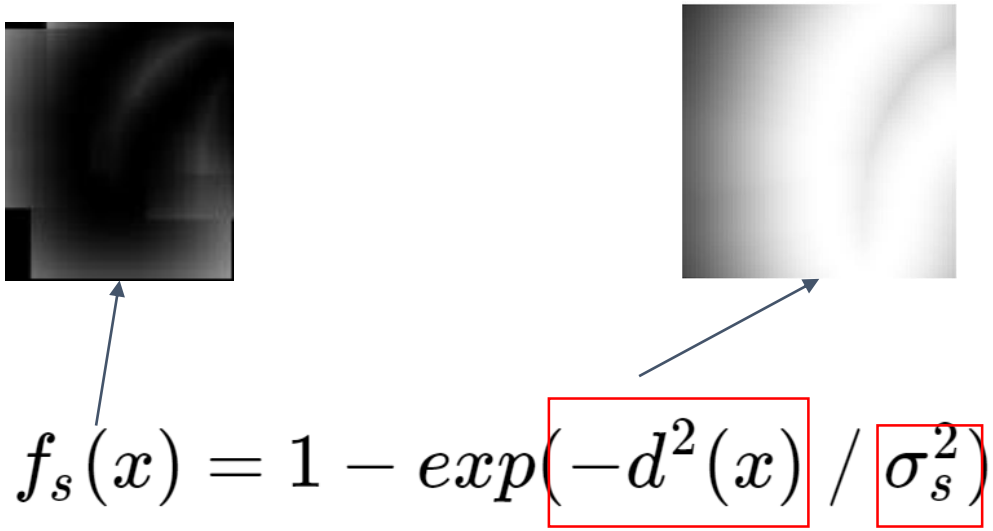
$$f_c = 1 - \frac{\int_{W_k} |L^t(x) - p_c(x)| \cdot \omega_c(x) dx}{\int_{W_k} \omega_c(x) dx}$$

$$\omega_c(x) = exp(-d^2(x) / \sigma_c^2$$

Color model (initColorModels.m)



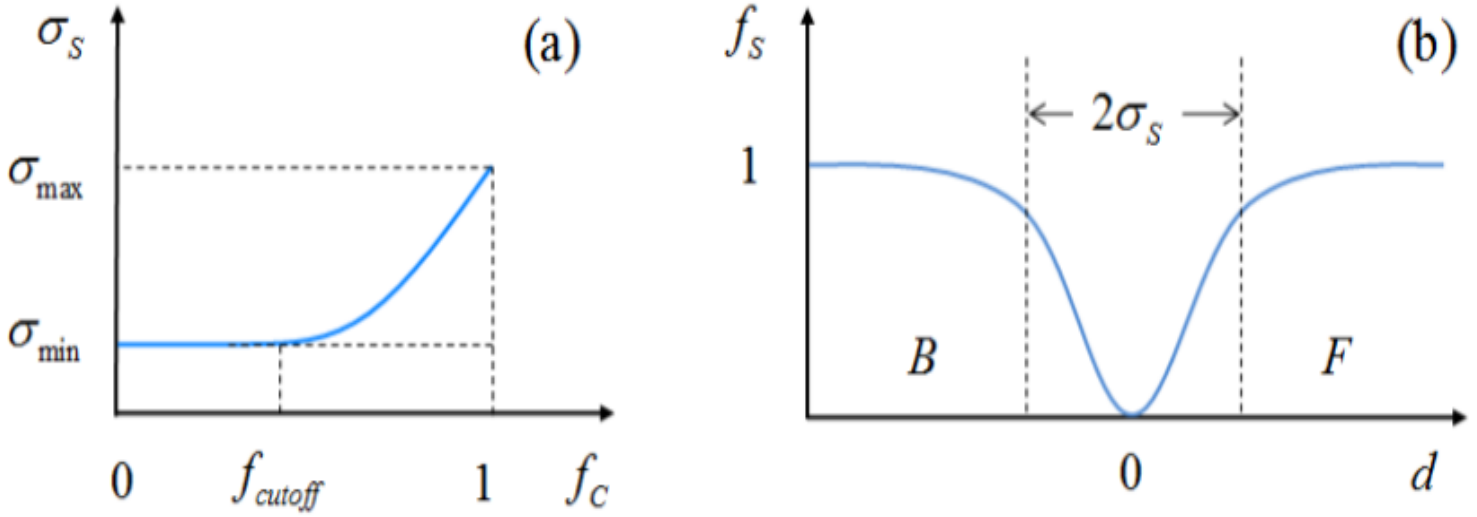
Shape model (initShapeConfidences.m)



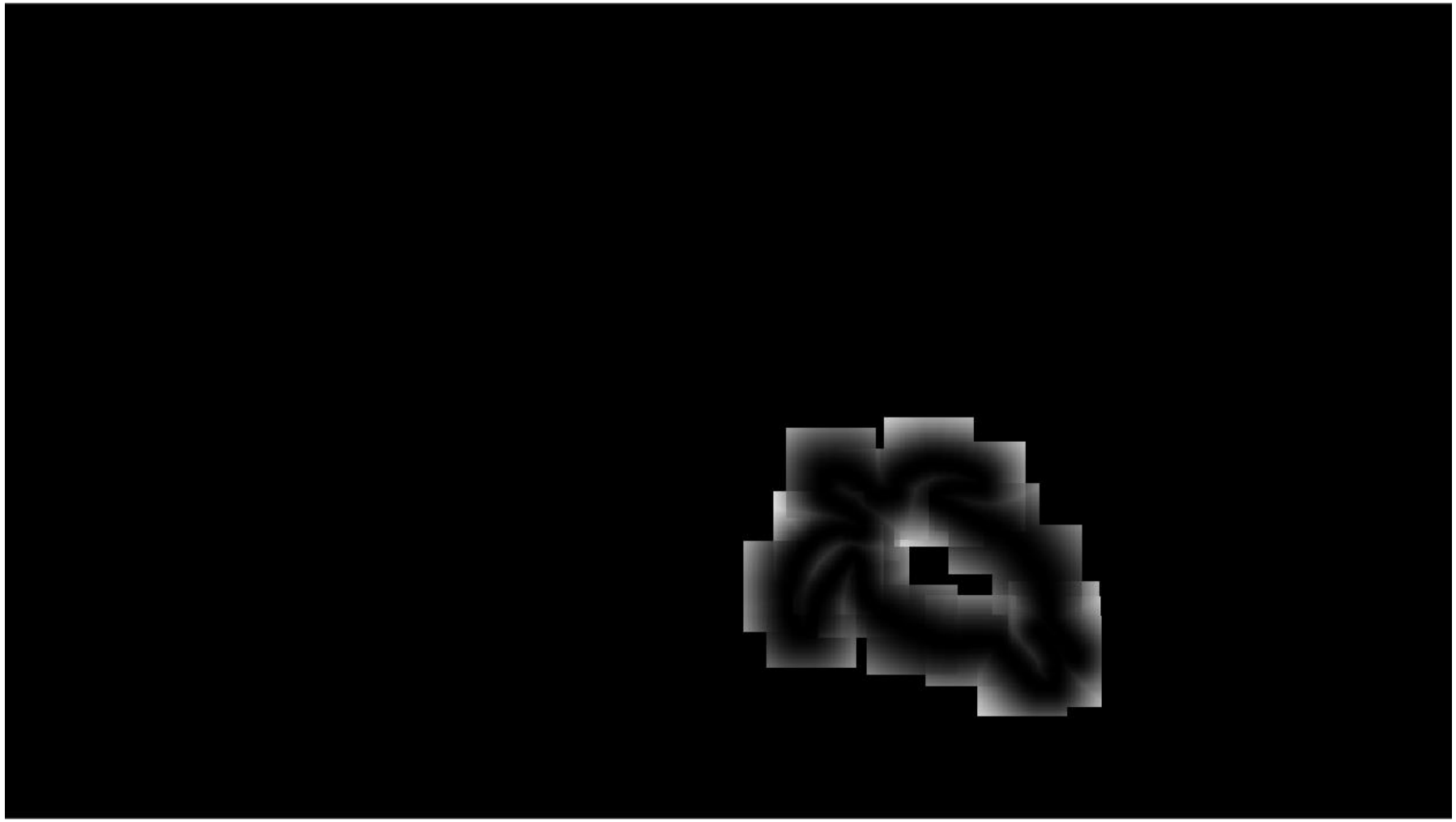
$$f_s(x) = 1 - exp(-d^2(x) \,/\, \sigma_s^2)$$

Shape model (initShapeConfidences.m)

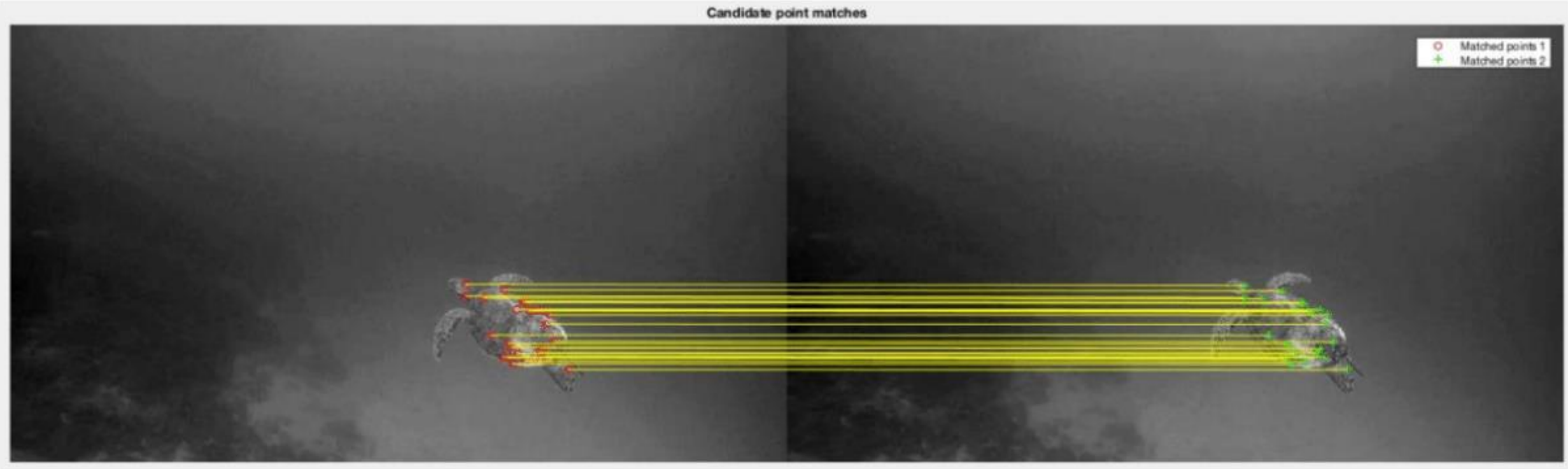
$$\sigma_s = \begin{cases} \sigma_{min} + a(f_c - f_{cutoff})^r & f_{cutoff} < f_c \leq 1, \\ \sigma_{min} & 0 \leq f_c \leq f_{cutoff}, \end{cases}$$



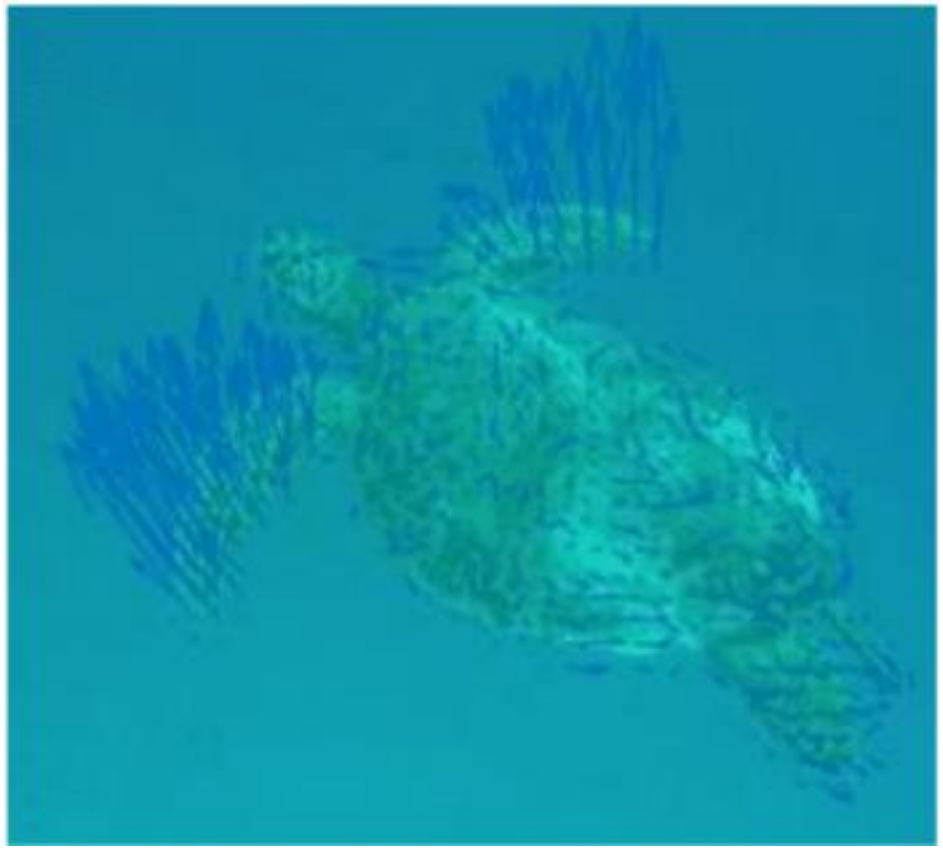
Shape model (initShapeConfidences.m)



Local Window Propagation (calculateGlobalAffine.m)



Optical Flow Wrapping (localFlowWrap.m)

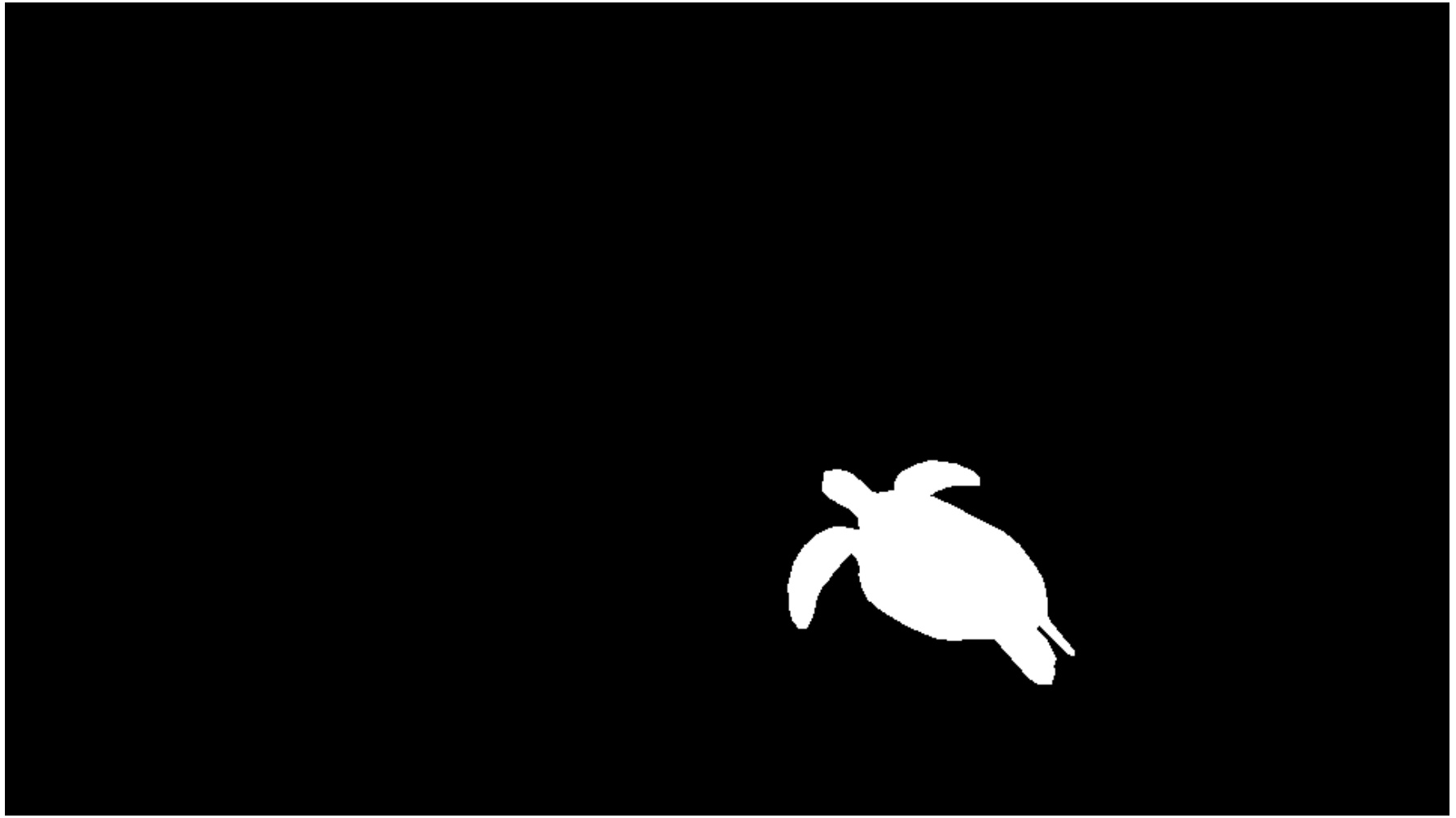


Updating the Shape and Color Models (updateModels.m)

$$p_{\mathcal{F}}^{k}(x) = f_s(x) L^{t+1}(x) + (1 - f_s(x))\, p_c(x)$$

$$p_{\mathcal{F}}(x) = \frac{\sum_k p_{\mathcal{F}}^{k}(x) \left(|x - c_k| + \epsilon\right)^{-1}}{\sum_k \left(|x - c_k| + \epsilon\right)^{-1}}$$

Updating the Shape and Color Models (updateModels.m)



Updating the Shape and Color Models (updateModels.m)

Pseudo-code (myRotobrush.m)

Algorithm 1 Rotobrush

```
1: procedure MYROTOBRUSH
2:     set parameters
3:     load images
4:     create mask
5:     initLocalWindows()                          ▷ initialize local window
6:     initColorModels()                           ▷ initialize Color model
7:     initShapeConfidences()                      ▷ initialize Shape model
8:     for every image do
9:         calculateGlobalAffine()   ▷ transform between previous and current frames
10:        localFlowWarp()                  ▷ local warping based on optical flow
11:        updateModels()                        ▷ update color and shape model
12:    end for
13: end procedure
```

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Deadline: Nov 13 2018 (Midnight)

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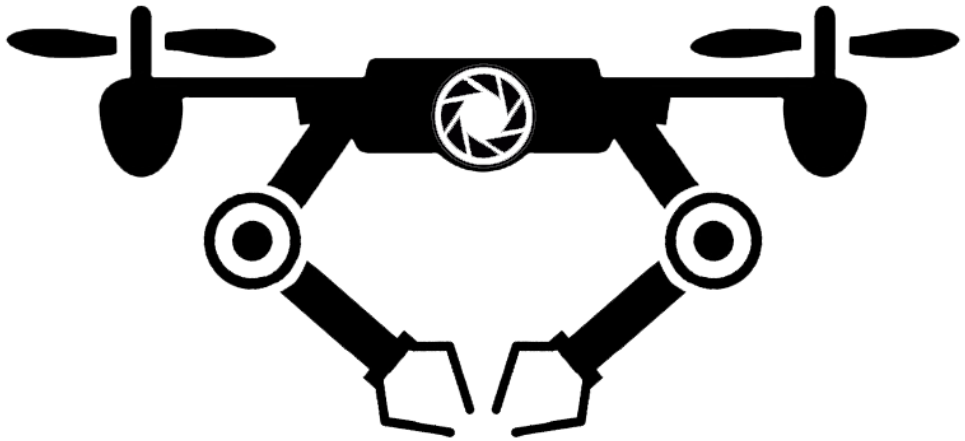
Thank You!



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