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MFPP: Morphological Fragmental Perturbation Pyramid for Black-Box Model Explanations

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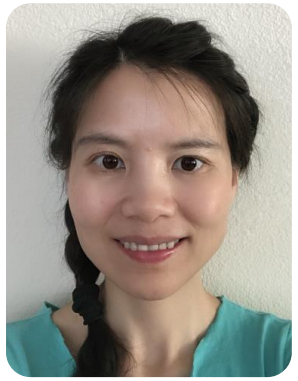
Yang Qing


Zhu Xia

Fwu Jong-Kae

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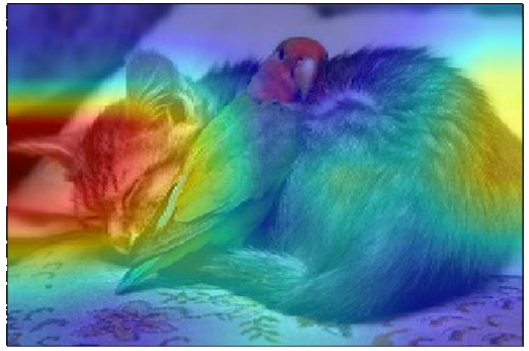
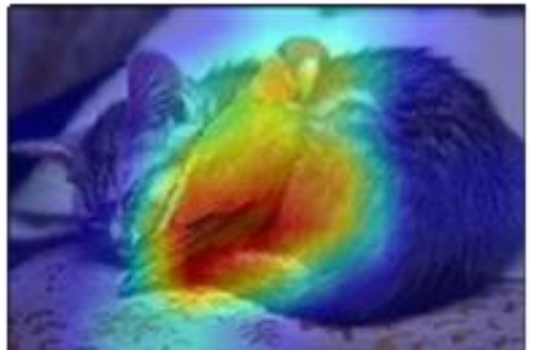
Bird-and-Cat Experiment

Egyptian_cat

Lorikeet





Importance Distribution in Saliency Map

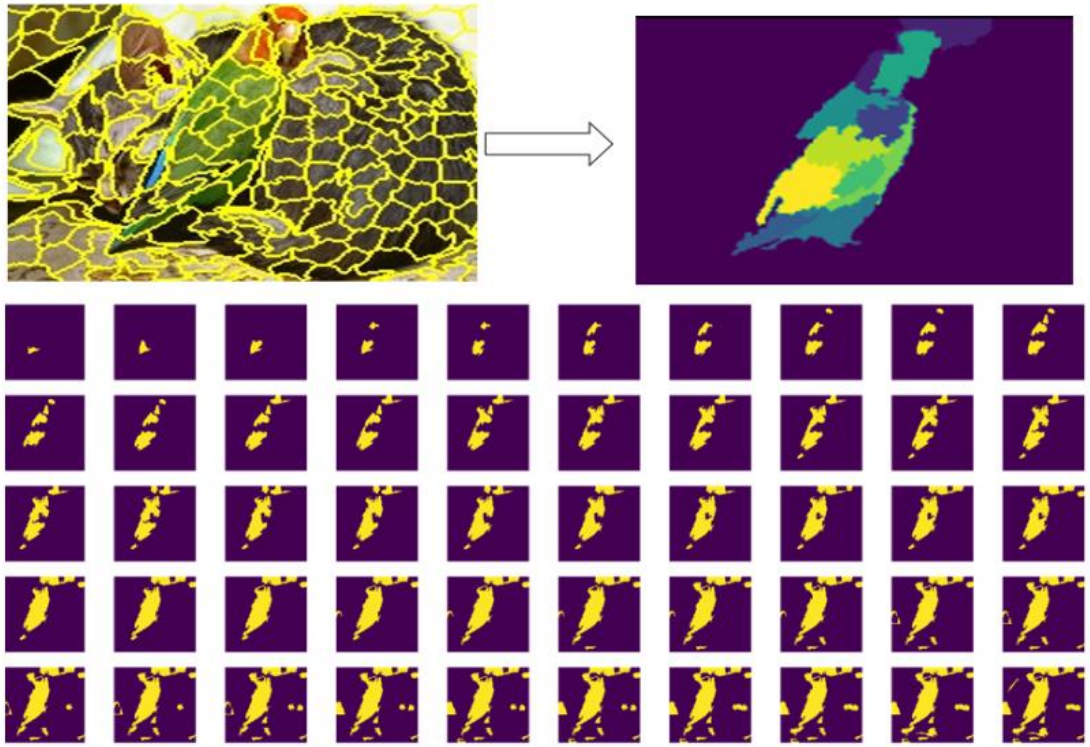
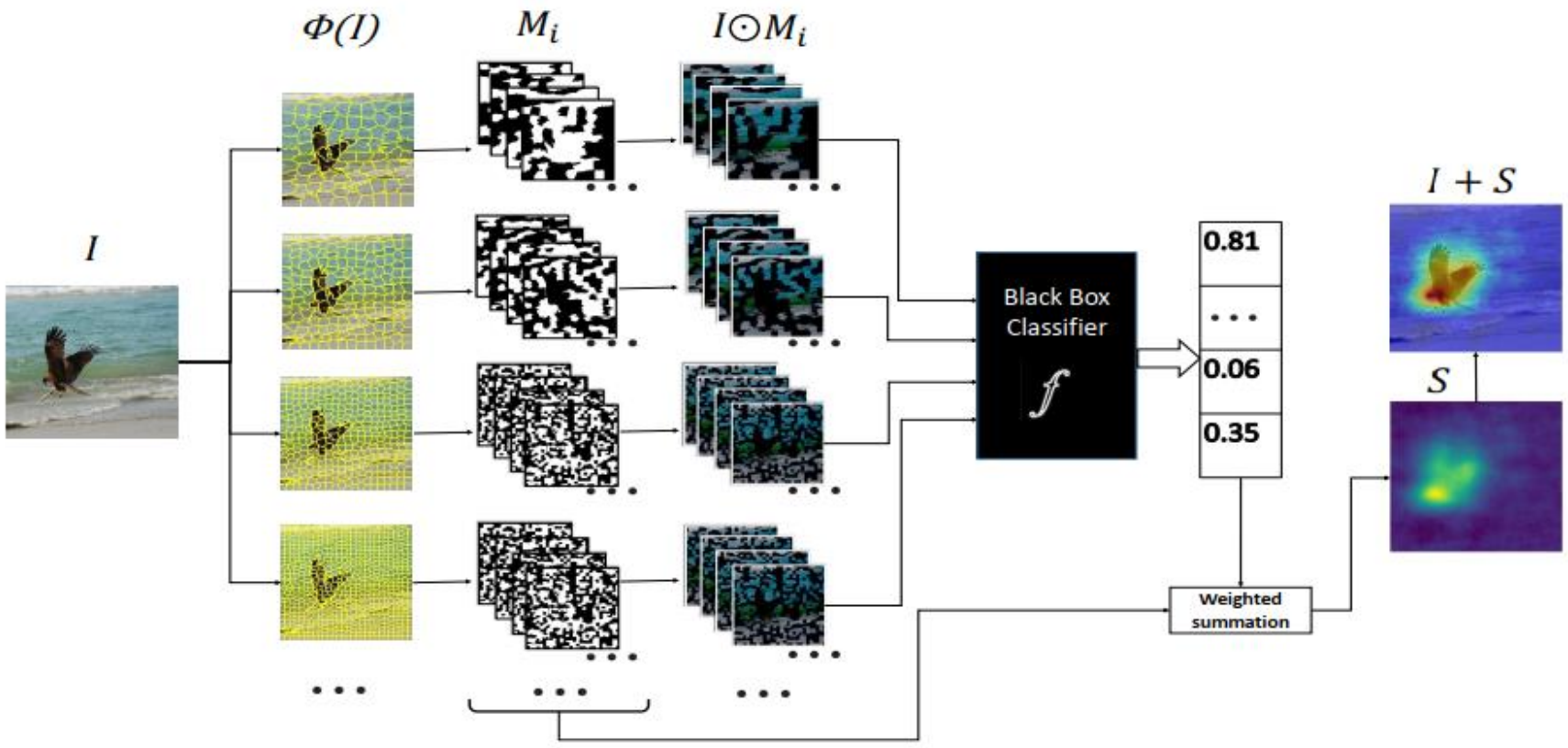


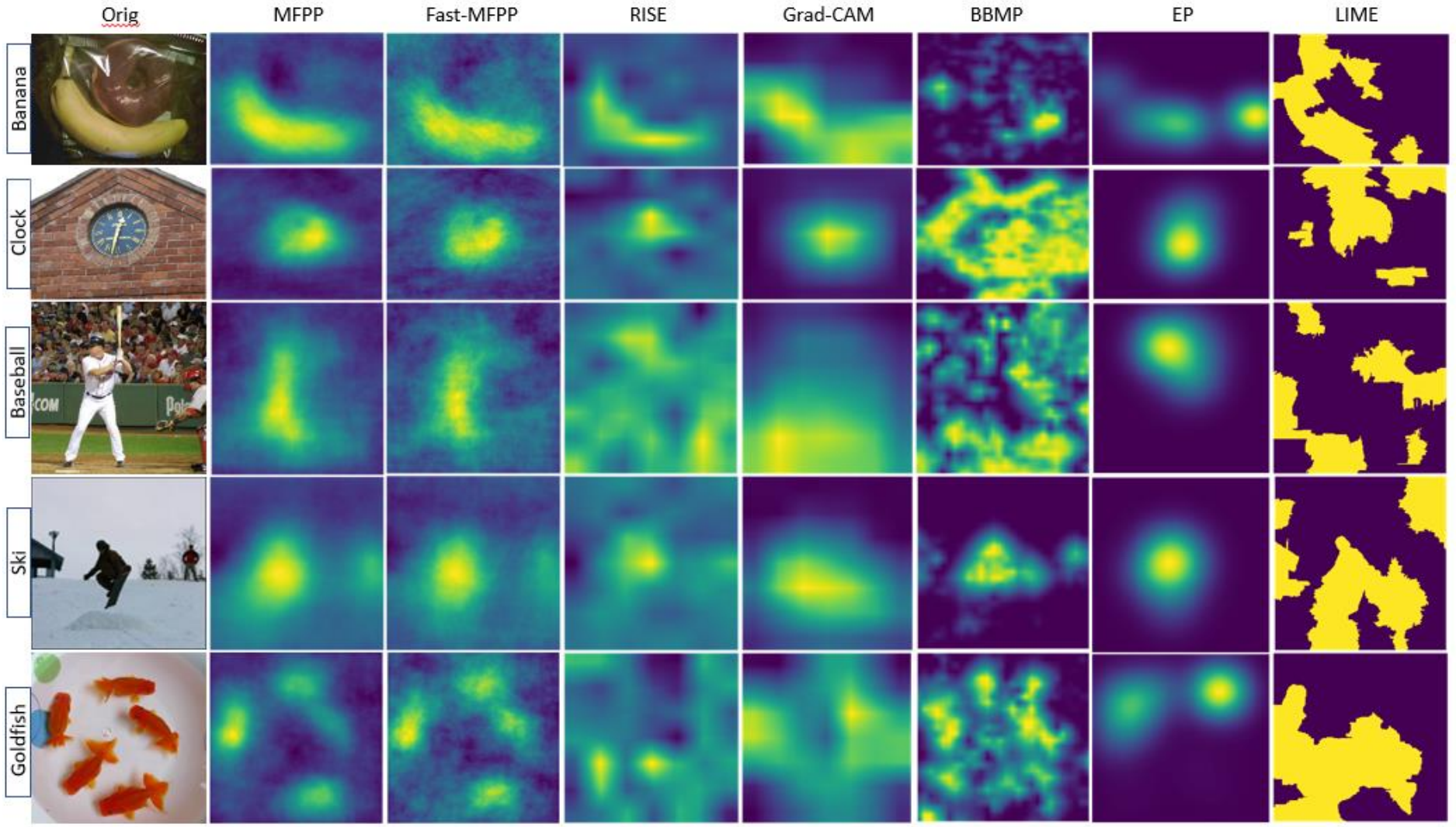
Fig. 3: Top-left: the superpixel result for 'bird-and-cat' picture. Top-right: disturb superpixels and statistically measure the "bird" score of each segment; Bottom: visualize the probability distribution of bird fragments from high to low.

MFPP Methodology



$$S_{I,\Phi}(\mu) = \frac{1}{E[M] \cdot \sum_{l=1}^{L} g(F_l)} \sum_{l=1}^{L} \sum_{i=1}^{g(F_l)} \Phi(I \odot M_{l,i}) \cdot M_{l,i}(\mu) \quad (4)$$

Benchmark : MFPP vs Previous works



Accuracy : MFPP vs Previous works

TABLE I: The Result of Pointing Game [30] on VOC2007 *test* and COCO2014 *minival* Dataset. Methods in Grey Color are for Black-box Model. EP's result on VOC07 is taken from [9].

Method	VOC07 Test		COCO14 MiniVal	
	VGG16	ResNet50	VGG16	ResNet50
Cntr.	69.6	69.6	27.6	27.6
Grad	76.3	72.3	37.4	35.4
DConv	67.5	68.6	30.5	30.2
Guid.	75.9	77.2	38.4	41.4
MWP	77.1	84.4	39.2	48.8
cMWP	79.9	90.7	49.8	57.4
Grad-CAM	86.6	90.4	54.0	57.0
RISE	86.4 ± 0.6	86.6 ± 1.0	51.1 ± 0.1	54.4 ± 0.4
EP	**88.0**	88.9	51.5 ± 0.1	56.1 ± 0.2
Fast-MFPP	86.1 ± 0.2	88.7 ± 0.4	50.6 ± 0.2	54.5 ± 0.3
MFPP	87.0 ± 0.1	$\mathbf{89.1 \pm 0.6}$	$\mathbf{52.0 \pm 0.2}$	$\mathbf{56.4 \pm 0.2}$

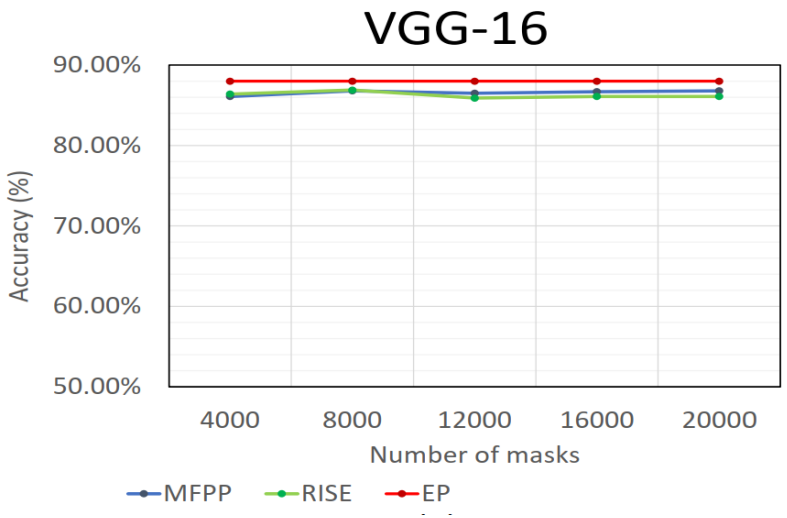
Pointing Game

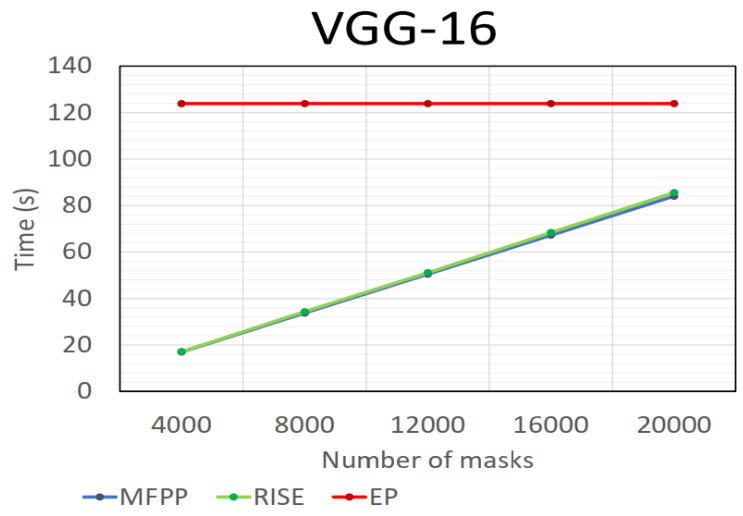
$$Acc = \frac{Hits}{Hits+Misses}$$

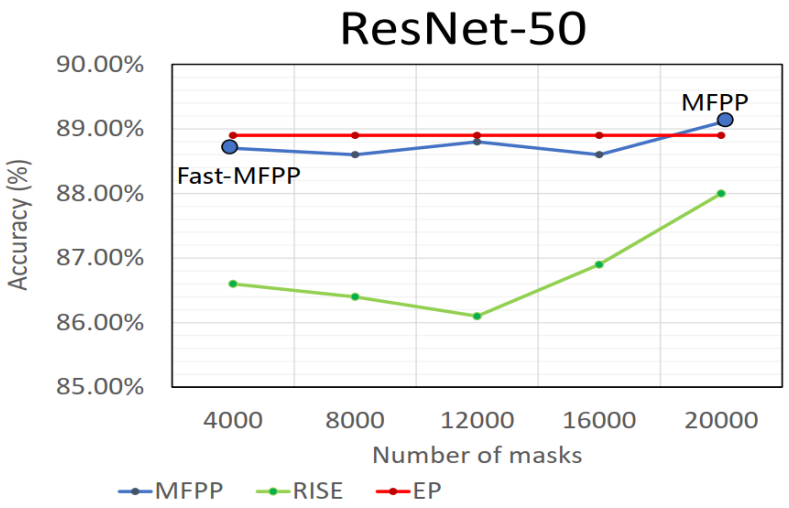
TABLE II: The Benchmark for Average Processing Time for Single Sample Explanation on VOC07 Test Dataset.

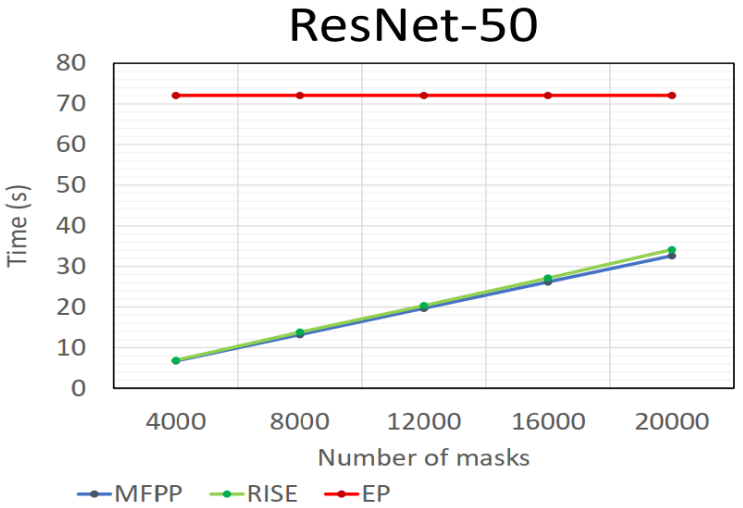
Method	VOC07 Test		COCO14 MiniVal	
	VGG16	ResNet50	VGG16	ResNet50
LIME	39.8 ± 0.9	32.3 ± 1.1	35.6 ± 1.0	30.2 ± 1.4
RISE	17.0 ± 0.1	13.5 ± 0.1	$\mathbf{9.1 \pm 0.3}$	19.8 ± 0.4
EP	123.9 ± 0.2	72.1 ± 0.1	92.6 ± 3.5	75.9 ± 0.5
Fast-MFPP	$\mathbf{16.9 \pm 0.1}$	$\mathbf{6.7 \pm 0.0}$	$\mathbf{9.1 \pm 0.3}$	$\mathbf{10.0 \pm 0.3}$
MFPP	83.9 ± 0.1	32.6 ± 0.1	45.1 ± 0.3	50.1 ± 0.2

Monte Carlo Sampling Volume Matters

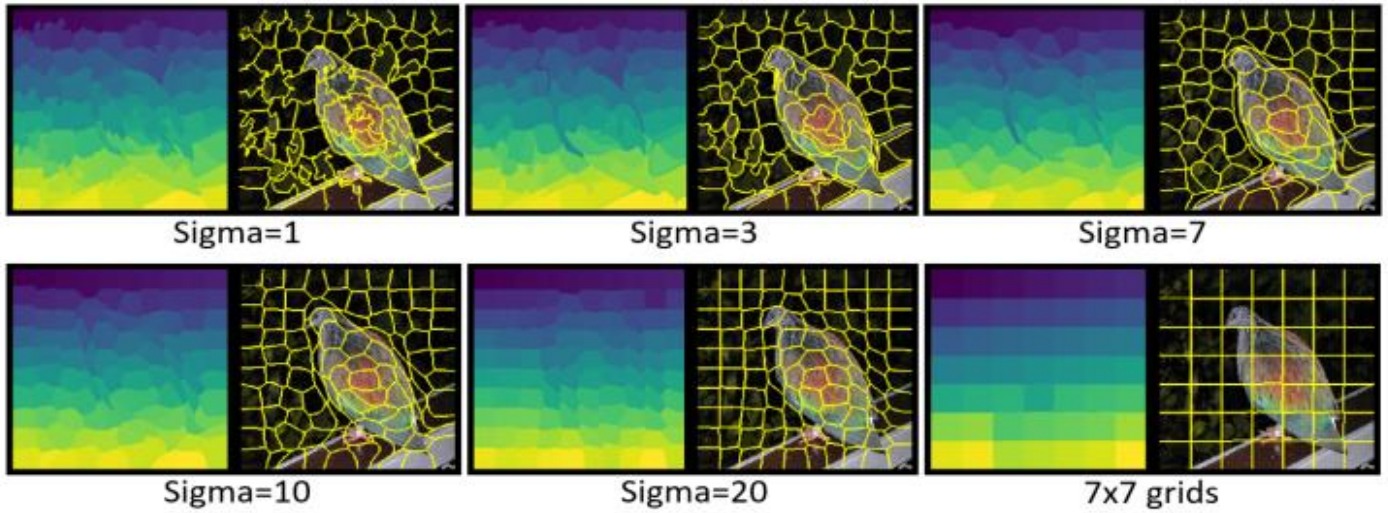


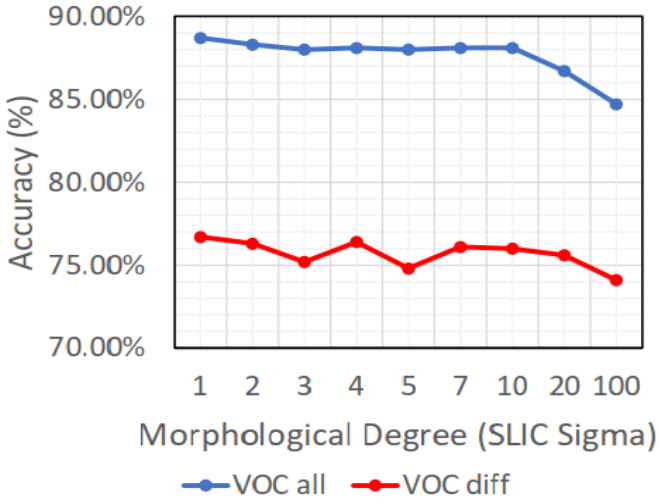




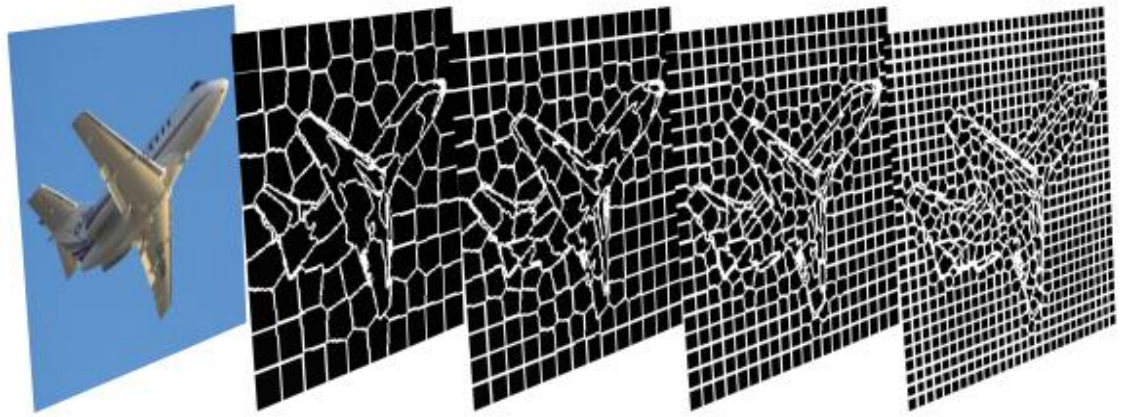


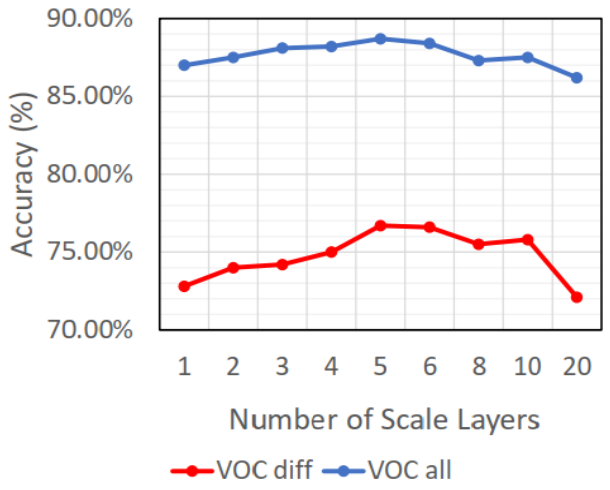
Ablation Study : Morphological Degree Matters

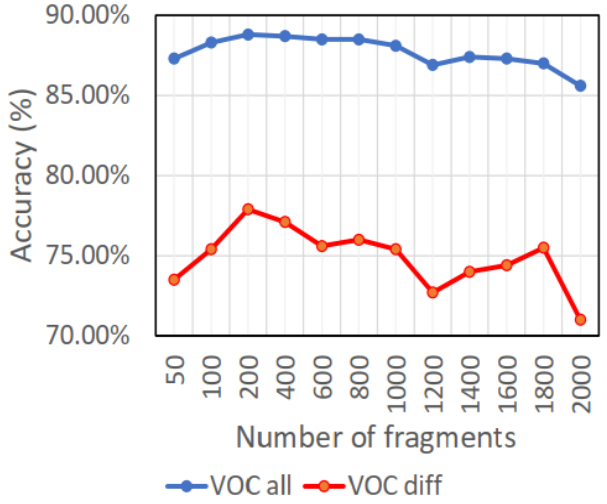




Ablation Study : Fragments Layer and Number Matter







THANK YOU !