中国科学技术大学
University of Science and Technology of China

NEURAL INFORMATION PROCESSING SYSTEMS

Exploring Figure-Ground Assignment Mechanism in Perceptual Organization

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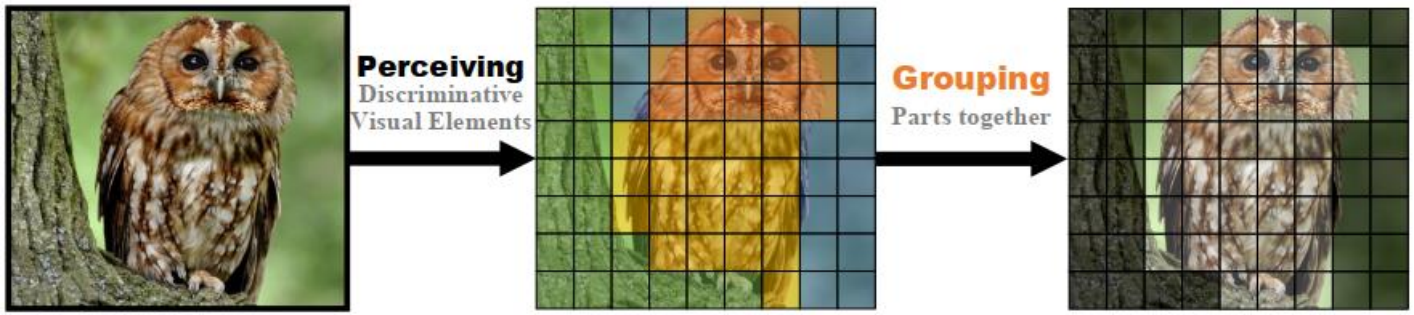
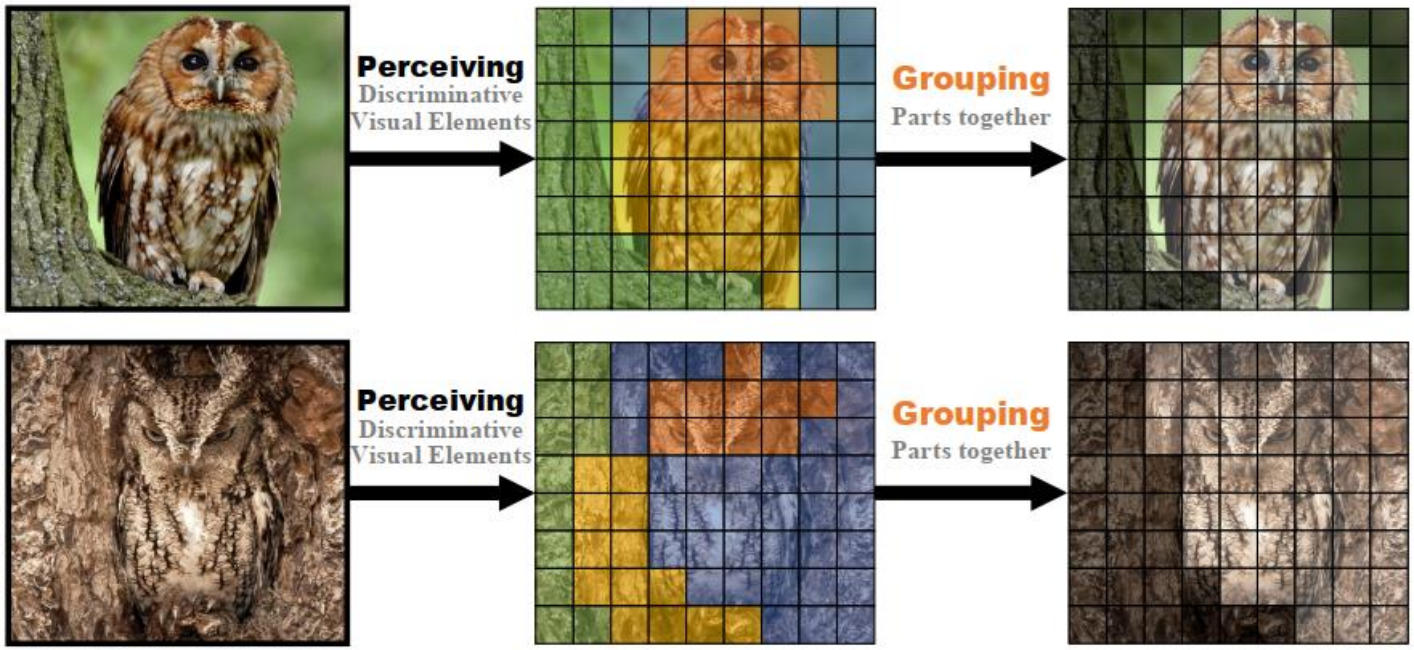
Motivation


Perceiving
Discriminative
Visual Elements
Grouping
Parts together

Motivation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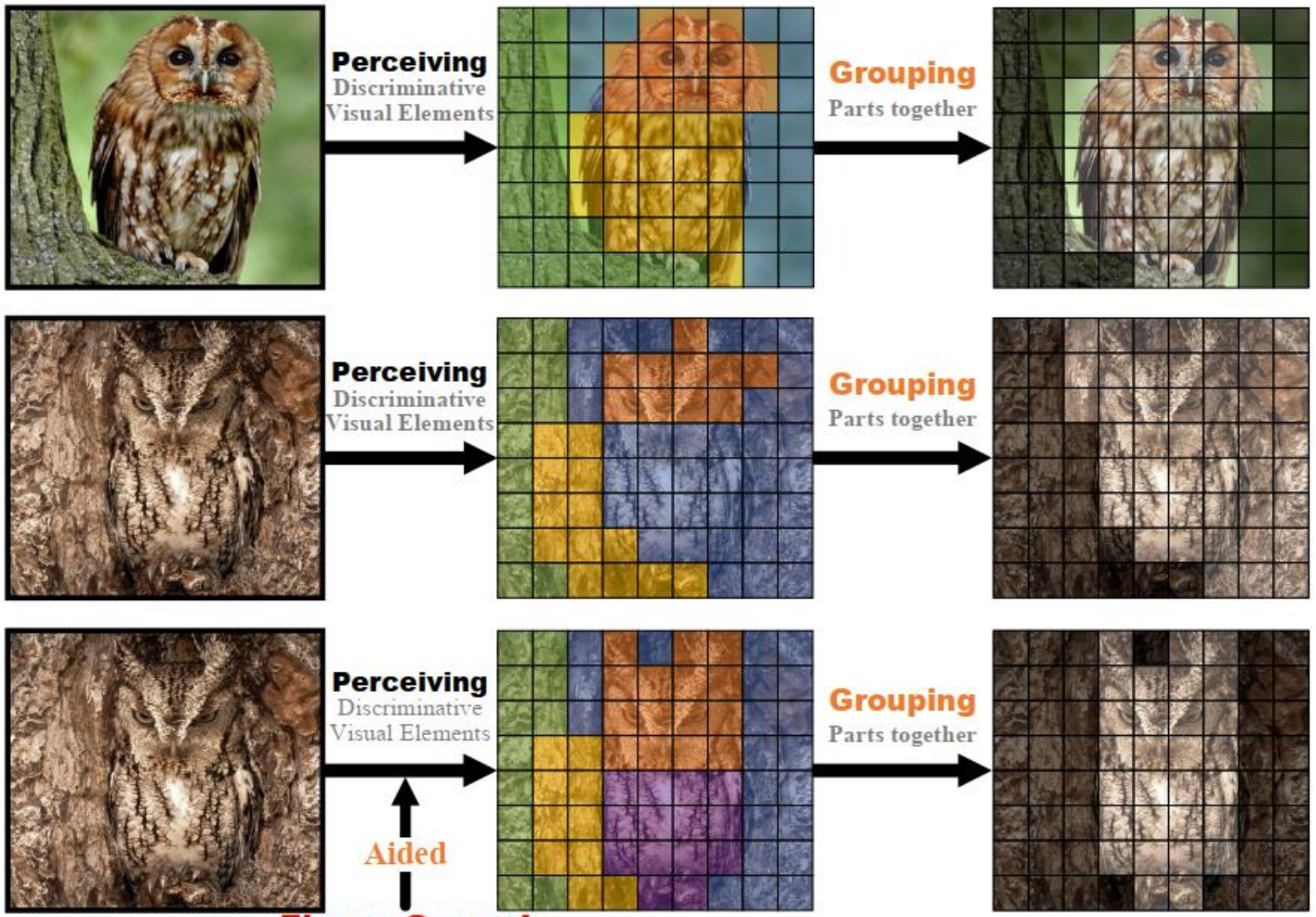

Method

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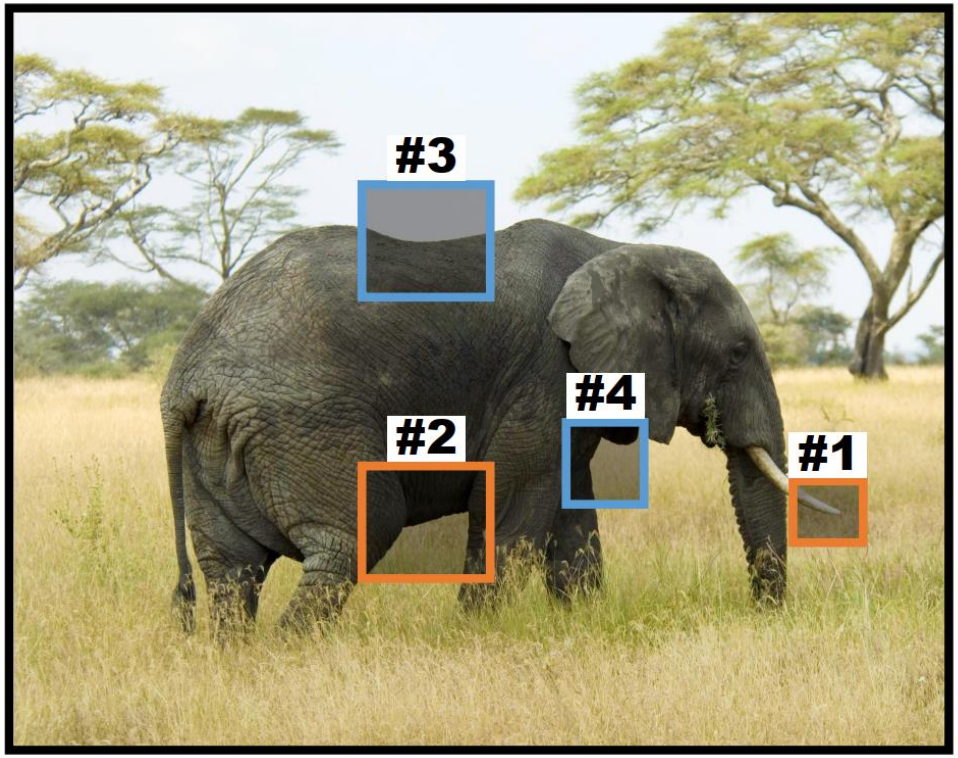
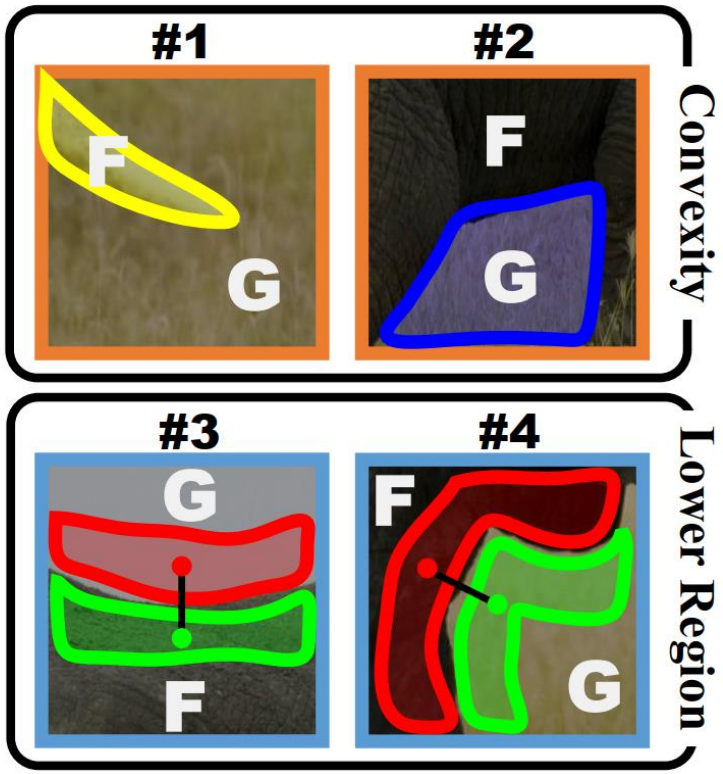
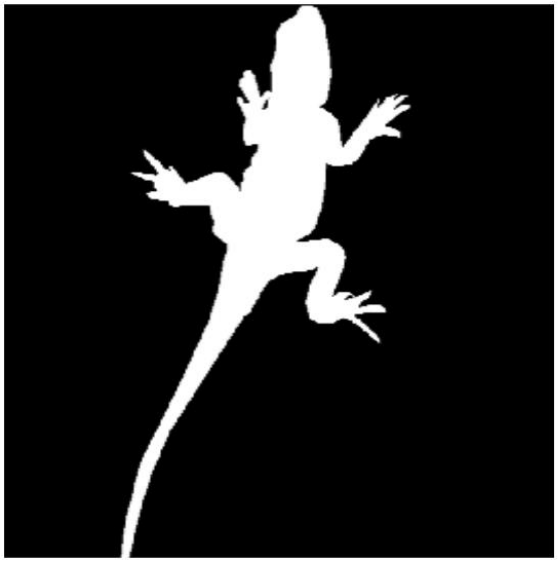
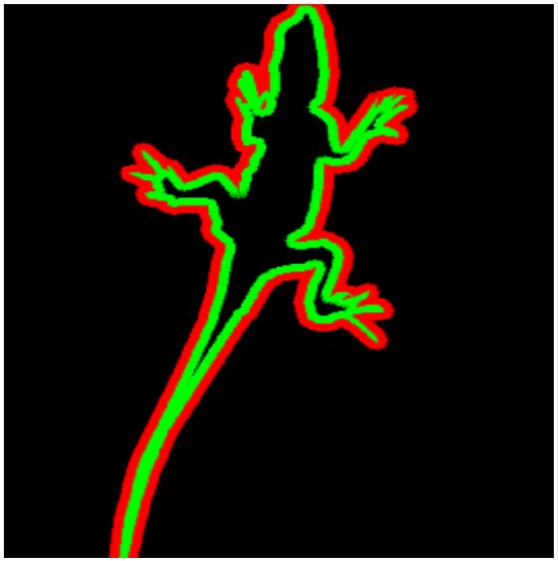




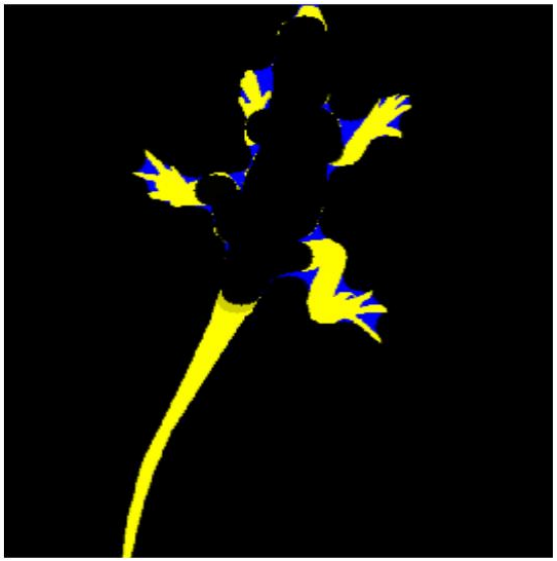
Method



GT

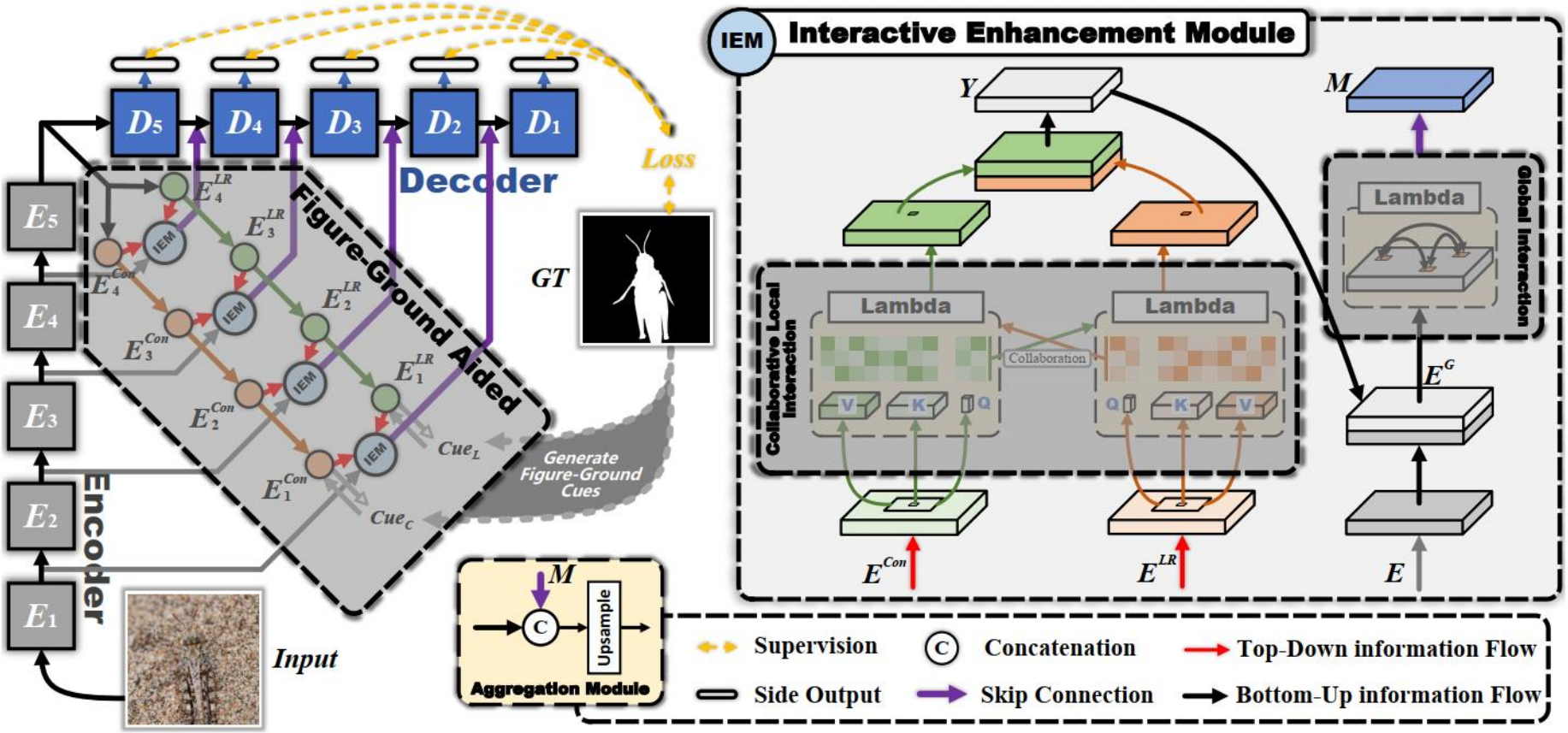


Lower Region

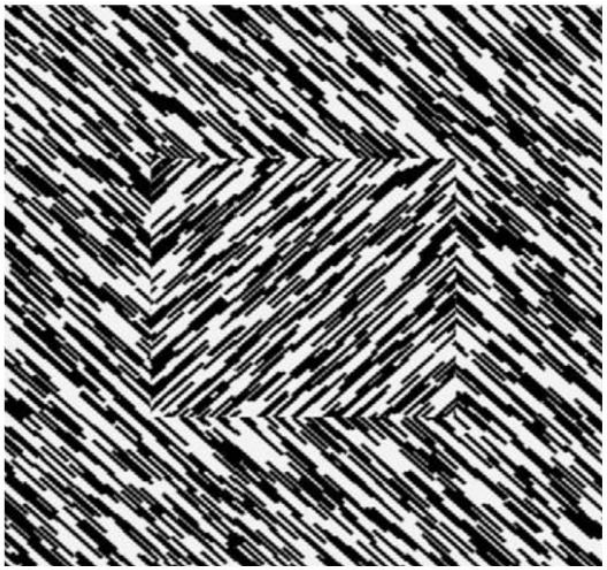


Convexity

Method


IEM
Interactive Enhancement Module
Y
M
Lambda
Lambda
Collaborative Local Interaction
Collaboration
Lambda
Global Interaction
V
K
Q
Q
K
V
E^{Con}
E^{LR}
E^{G}
E
D5
D4
D3
D2
D1
Decoder
Loss
GT
E5
E4
E3
E2
E1
Encoder
Figure-Ground Aided
E_4^{LR}
E_3^{LR}
E_2^{LR}
E_1^{LR}
E_4^{Con}
E_3^{Con}
E_2^{Con}
E_1^{Con}
IEM
Cue_L
Cue_C
Generate Figure-Ground Cues
Input
M
C
Upsample
Aggregation Module
Supervision
Concatenation
Top-Down information Flow
Side Output
Skip Connection
Bottom-Up information Flow

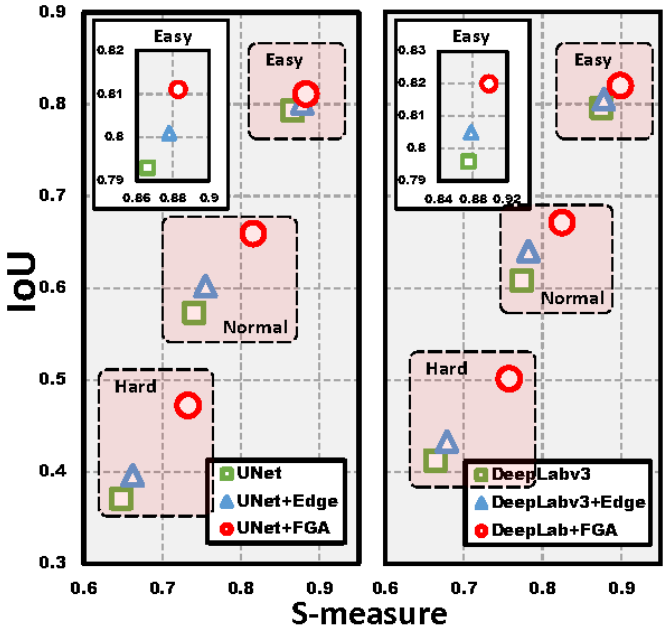
Experiment

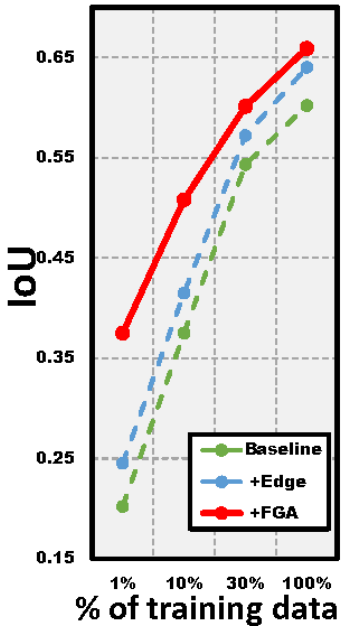


Human Test

Figure-Ground Segregation Test

Experiment


IoU
S-measure
Easy
Normal
Hard
UNet
UNet+Edge
UNet+FGA
DeepLabv3
DeepLabv3+Edge
DeepLab+FGA


IoU
% of training data
1%
10%
30%
100%
Baseline
+Edge
+FGA

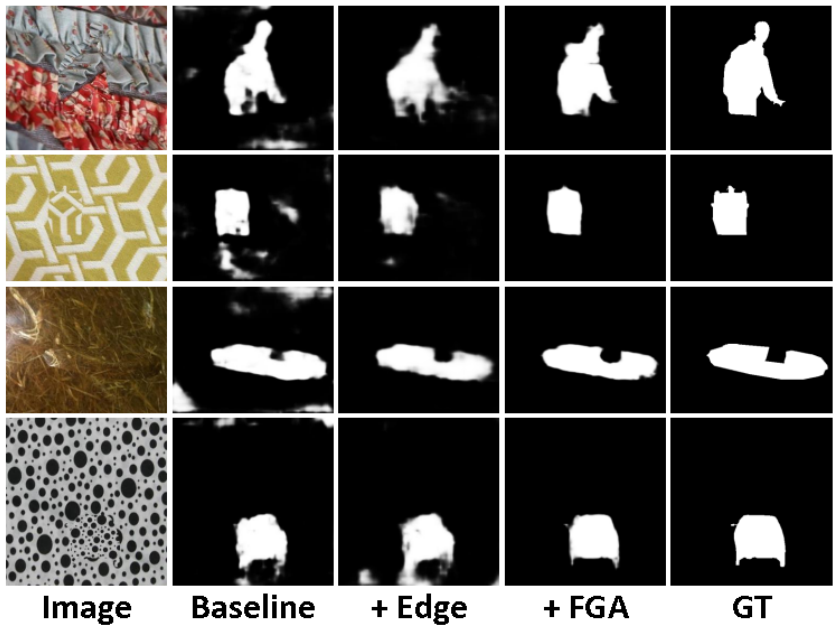


Image
Baseline
+ Edge
+ FGA
GT

Experiment

Table 2: **Comparison with 6 SOTA methods on the CHA [59], CAM [27], and COD [11] datasets.** ↑ indicates higher is better.

		[78]	[11]	[10]	[70]	[38]	[69]	Ours
CHA [59]	$S(\uparrow)$	.848	.869	.888	.893	.882	.888	**.902**
	$E(\uparrow)$	.870	.891	.942	.923	.942	.918	**.947**
	$F(\uparrow)$	.702	.740	.816	.813	.810	.796	**.840**
	$M(\downarrow)$	.050	.044	**.030**	**.030**	.033	.031	**.030**
CAM [27]	$S(\uparrow)$	.732	.751	**.820**	.775	.782	.785	.803
	$E(\uparrow)$	.768	.771	**.882**	.847	.852	.859	.871
	$F(\uparrow)$	.583	.606	.743	.673	.695	.686	**.748**
	$M(\downarrow)$	.104	.100	.070	.088	.085	.086	**.068**
COD [11]	$S(\uparrow)$	.727	.771	.815	.814	.800	.818	**.821**
	$E(\uparrow)$	.779	.806	.887	.865	.868	.850	**.895**
	$F(\uparrow)$	.509	.551	.680	.666	.660	.667	**.687**
	$M(\downarrow)$	.056	.051	.037	.035	.040	.035	**.031**

Table 3: **Comparison with six SOTA methods on the COVID-19 CT segmentation dataset.**

	Dice(↑)	Sen.(↑)	Spec.(↑)	$S(\uparrow)$	$E(\uparrow)$	$M(\downarrow)$
[50]	.439	.534	.858	.622	.625	.186
[41]	.583	.637	.921	.744	.625	.112
[54]	.623	.658	.926	.725	.739	.102
[29]	.515	.594	.840	.655	.814	.184
[82]	.581	.672	.902	.722	.662	.120
[13]	.682	.692	.943	.781	.720	.082
[20]	.700	**.751**	–	–	.860	.084
Ours	**.754**	.748	**.973**	**.799**	**.911**	**.056**

Table 4: **Performance on DUTS-Test [65] and PASCAL-S [30].**

	DUTS-Test				PASCAL-S			
	$M(\downarrow)$	$F(\uparrow)$	$S(\uparrow)$	$E(\uparrow)$	$M(\downarrow)$	$F(\uparrow)$	$S(\uparrow)$	$E(\uparrow)$
[79]	.041	.807	.885	.914	.062	.800	.858	.891
[67]	.035	.840	.892	.927	.062	.825	.862	.901
[28]	**.032**	.866	.899	.937	**.061**	.824	.863	.903
Ours	.033	**.868**	**.902**	**.940**	**.061**	**.827**	**.866**	**.907**

Table 5: **Comparison with four SOTA methods on Kvasir, CVC-612, ColonDB, ETIS, and Endo datasets.**

		[50]	[82]	[14]	[12]	[80]	Ours
Kvasir [18]	Dice(↑)	.818	.821	.723	.898	.907	**.911**
	IoU(↑)	.746	.743	.611	.840	**.862**	.858
	$F(\uparrow)$	.794	.808	.670	.885	.893	**.898**
	$S(\uparrow)$	.858	.862	.782	.915	.922	**.922**
	$E^m(\uparrow)$	.893	.910	.849	.948	.944	**.953**
	$M(\downarrow)$	.055	.048	.075	.030	.028	**.025**
CVC-612 [2]	Dice(↑)	.823	.794	.700	.899	.921	**.924**
	IoU(↑)	.755	.729	.607	.849	.879	**.884**
	$F(\uparrow)$	.811	.785	.647	.896	.914	**.930**
	$S(\uparrow)$	.889	.873	.793	.936	.941	**.943**
	$E^m(\uparrow)$	.954	.931	.885	.979	.972	**.982**
	$M(\downarrow)$	.019	.022	.042	.009	**.008**	**.008**
ColonDB [60]	Dice(↑)	.512	.483	.469	.709	.755	**.768**
	IoU(↑)	.444	.410	.347	.640	.678	**.683**
	$F(\uparrow)$	.498	.467	.379	.696	.737	**.746**
	$S(\uparrow)$	.712	.691	.634	.819	.836	**.842**
	$E^m(\uparrow)$	.776	.760	.765	.869	**.883**	.868
	$M(\downarrow)$	.061	.064	.094	.045	.041	**.040**
ETIS [58]	Dice(↑)	.398	.401	.297	.628	.719	**.723**
	IoU(↑)	.335	.344	.217	.567	**.664**	.651
	$F(\uparrow)$	.366	.390	.231	.600	.678	**.680**
	$S(\uparrow)$	.684	.683	.557	.794	**.840**	.822
	$E^m(\uparrow)$	.740	.776	.633	.841	.830	**.834**
	$M(\downarrow)$	.036	.035	.109	.031	.020	**.015**
Endo [61]	Dice(↑)	.710	.707	.467	.871	.869	**.889**
	IoU(↑)	.627	.624	.329	.797	.807	**.817**
	$F(\uparrow)$	.684	.687	.341	.843	.849	**.865**
	$S(\uparrow)$	.843	.839	.640	.925	.925	**.929**
	$E^m(\uparrow)$	.876	.898	.817	.972	.943	**.978**
	$M(\downarrow)$	.022	.018	.065	.010	.010	**.007**

Thanks!