



Occlusion Copy & Paste for MOTOR GROUP **Occluded Human Instance Segmentation**

Evan Ling, Dezhao Huang, Minhoe Hur

AIR Center, Hyundai Motor Group Innovation Center in Singapore

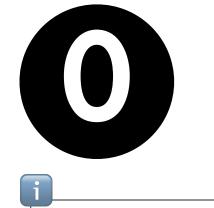


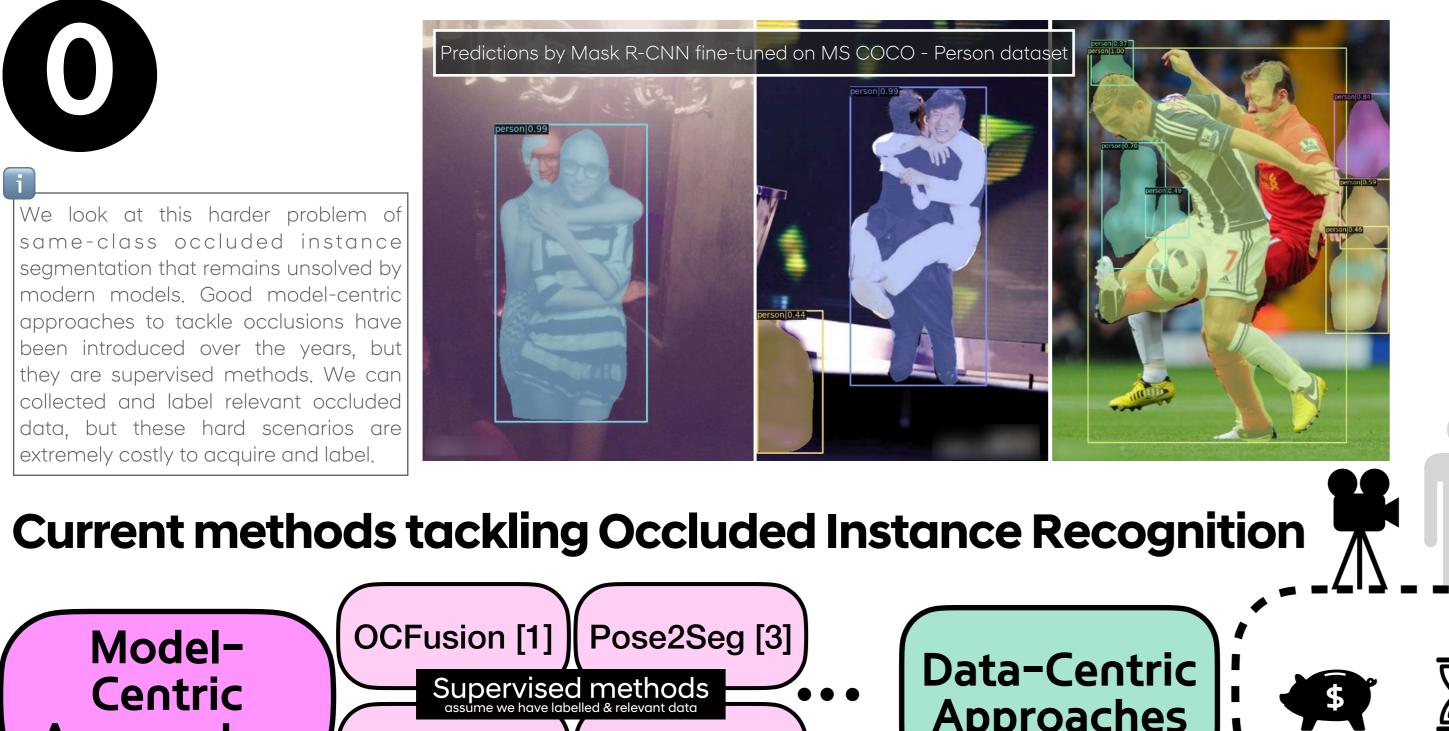
[11, 15]

improve performance.

[16, 20]

A Difficult Problem: Same-class Occluded Instance Segmentation





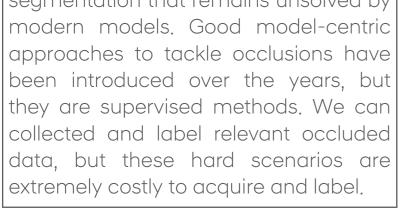
Add-ons

Are our synthesized images realistic?

(1) Photo Realism: We got around this by copy & pasting

(2) Semantic Realism: Relatively lacking here

But do we really need perfect realism?



Model-

Centric

Approaches

Starting from our simple approach:

PoSeg [4]

BCNet [2]

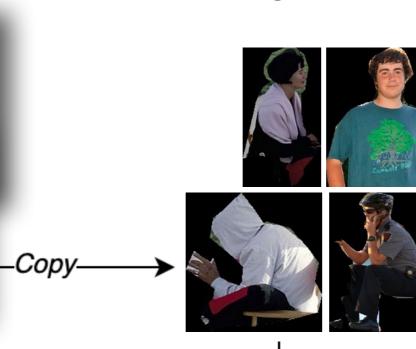
[1] Lazarow et al. CVPR, 2020. [2] Ke et al. CVPR, 2021

[3] Zhang et al. CVPR, 2019. [4] Zhou et al. IEEE Access, 2020.



With these considerations i mind, we introduce a datacentric approach, Occlusion Copy & Paste to directly nduce occluded scenarios and feed relevant examples to model during training as an online augmentation approach. This allow us to

Basket of Images Pasting Instances



Approaches

Occlusion Copy &

Paste (ours)

l Instances **Realism Enhancements:** We experiment if we require perfect realism in our augmentation in Min Size Filter Scale-aware Pasting other to train generalisable model. As it turns out, imposing such realism controls actually restricts Better quality masks Blending scope of variability and does not

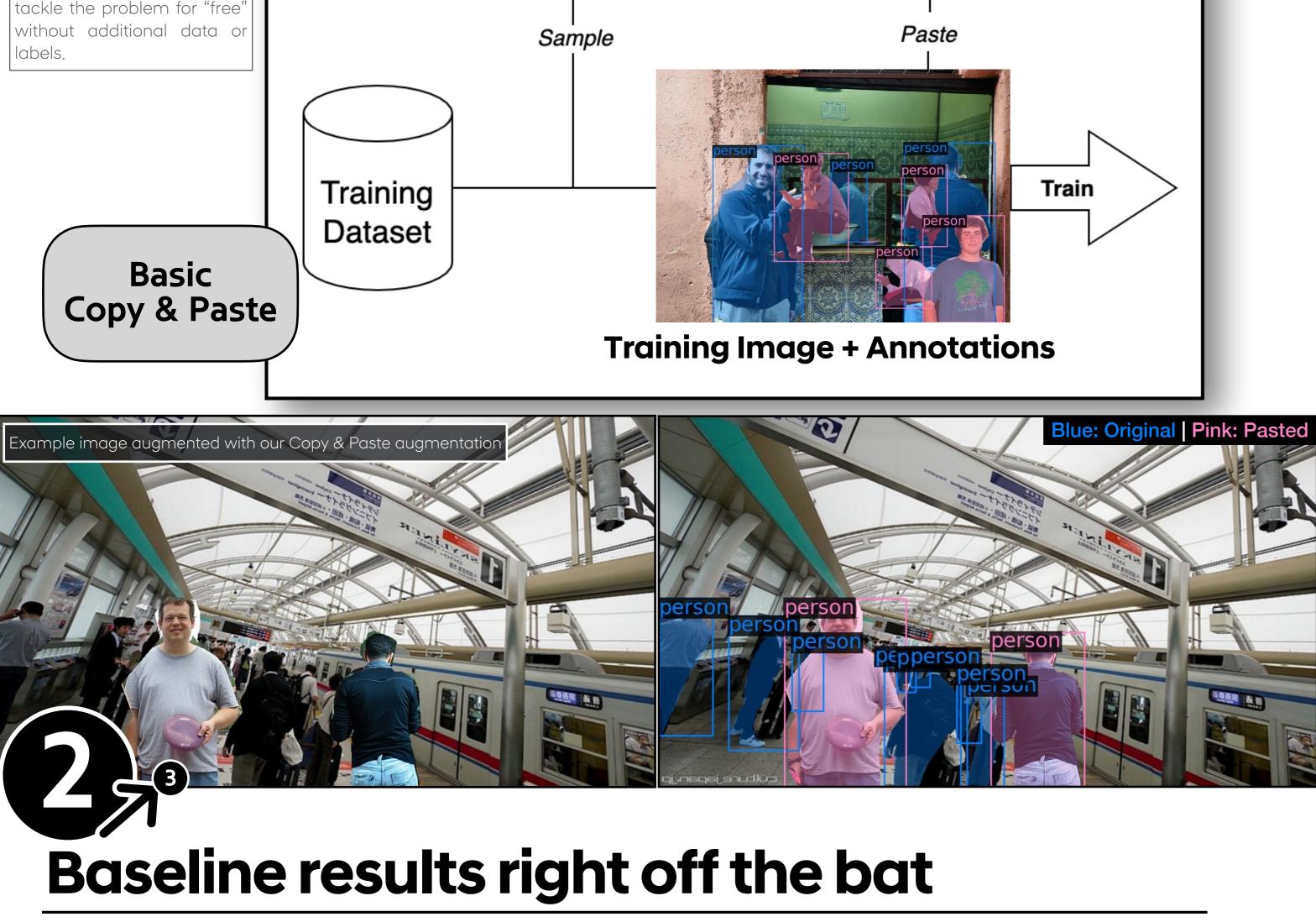
Realism isn't favoured over variability

copy & paste add-ons	\boldsymbol{AP}^{val}		AP^{test}	
Basic Copy & Paste	18.6		17.8	
Minimum Pasting Size	18.8		18.5	
Minimum Pasting Size + Scale Aware	$-1\bar{8}.\bar{2}$	-0.6	18.2	-0.3
Minimum Pasting Size + Better Quality Mask	18.4	-0.4	18.0	-0.5
Minimum Pasting Size + Blend (Fixed)	18.6	-0.2	17.9	-0.6
Minimum Pasting Size + Blend (Random)	19.0	+0.2	18.4	-0.1

Increasing Efficiency & Variability

copy & paste add-ons	\boldsymbol{AP}^{val}		$\mathbf{A}\mathbf{P}^{test}$	
Basic C&P, $R_{paste} = [1, 10]$	18.6		17.8	
+ Targeted	18.6	+0.0	18.2	+0.4
Basic C&P, $R_{paste} = [1,3]$	17.9		17.5	
+ Targeted	19.1	+1.2	18.0	+0.5
+ Targeted & Augm. Paste	19.2	+1.3	18.4	+0.9
+ Targeted, Augm. Paste & Min. Size	19.5	+1.6	18.6	+1.1





Tusining Americal	OCH	uman	OCHu	COCO		
Training Approach	$\boldsymbol{A}\boldsymbol{P}^{val}$	AP^{test}	$oldsymbol{A}oldsymbol{P}^{val}$	AP^{test}	$\boldsymbol{AP}_{person}^{val}$	

Our eventual Occlusion Copy & Paste on the SOTA

Example image augmented with our Copy & Paste augmentation	vith our Copy & Paste augmentation Model		External Pose Model	Modelled for Occlusion	$\begin{array}{c} \mathbf{OCH} \\ \mathbf{AP}^{val} \end{array}$	uman AP ^{test}	OCHu AP ^{val}	man ^{FL} AP ^{test}					
E STATISTICS		TE 2			AND A CANA DO		Pose2Seg [§] [3]	/		_	_	22.8+	22.9+
		person	person			4	+ Occlusion C&P (ours)	V	V	-	-	<u>25.3</u> ⁺	<u>25.1</u> ⁺
			person	person person	on the second seco		Mask R-CNN [§] [6]		~ ~ -	14.9	14.9	24.5	24.9
							Mask R-CNN [†]	X	X	16.5	16.6	27.0	27.4
							+ Occlusion C&P (ours)			<u>19.5</u>	<u>18.6</u>	<u>30.6</u>	<u>_29.9</u>
		ulture japan.jp					PoSeg (JoPoSeg)[4]	×		25.8*	26.4*	-	-
			-	_			PoSeg (ExPoSeg)	✓	V	26.4*	26.8*		
Baseline results	right	t off tl	ne bo	Jt			Mask2Former [§] [7]			25.9	25.4	43.2	44.7
	OCF	Iuman	OCH	ıman ^{FL}	COCO		Mask2Former [†]	X	X	26.7	26.3	45.2	46.4
Training Approach	AP^{val}	AP^{test}	AP^{val}	AP^{test}	AP_{person}^{val}		+ Simple Copy-Paste ^[8]			28.0	27.7	48.9	50.2
$\mathbf{D}_{\mathbf{r}} = \mathbf{f}_{\mathbf{r}} = \mathbf{f}_{\mathbf{r}} = \mathbf{f}_{\mathbf{r}} = \mathbf{f}_{\mathbf{r}}$							+ Occlusion C&P (ours)			28.9	28.3	49.3	50.6
Pre-trained from [5] Baseline vanilla training	14.9 16.5	14.9 16.6	24.5 27.0	24.9 27.4	47.5 48.7		[3] Zhang et al. Pose2seg. CVPR, 2019. [6] He e [7] Cheng et al. Mask2Former. CVPR, 2022. [8] (t al. Mask r-cnn. ICCV, Ghiasi et al. Simple coj	2017. [4] Zhou et al. F by-paste. CVPR, 2021	Poseg. IEEE Access	s, 2020.		
										odolo o			_
+ Basic Copy & Paste (ours)	18.6	17.8	29.3	28.5	49.2		Easily interope		-	•		strating	J
[5] Kai et al. Mmdetection: Open mmlab detection toolbox	anu penchmark	. arAiv. 1900.07 155, 2	2019.				strong potentic	Il of date	I-centric	approc	aches		
MaskRCNN MaskRCNN		Mask	2Former				Mask2Former with Occ	lusion Co	nv & Paste	(ours)			
w/ OC&P (ou	irs)	Mask											
		-					a larger -		95b person[0.91	-	The second s		
person 0.99		person	person 0.59}7		person 0.94 ^{0.87}		2. 1.2 -	The MIT	person(0.89				- 2
						persol pe	pon 0.82 erson 0.95 erson 0.95						
		V 🛋 🛛 🤇		1									
											1		
		personijo.oo)] person[0.31		PAR	The second				
										R			
											and all all all all all all all all all al		

