Tilting at windmills

Data augmentation for deep pose estimation does not help with occlusion

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Challenges: Occlusions

Dense, overlapping person instances

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Unusual poses with occlusions

How to check robustness to occlusion?

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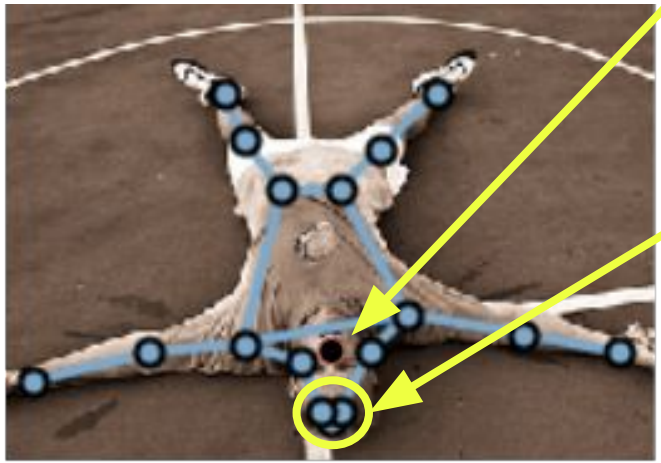
A: Occlusion Attacks

Keypoint attacks

Occlusion attacks - keypoint level

Original Image

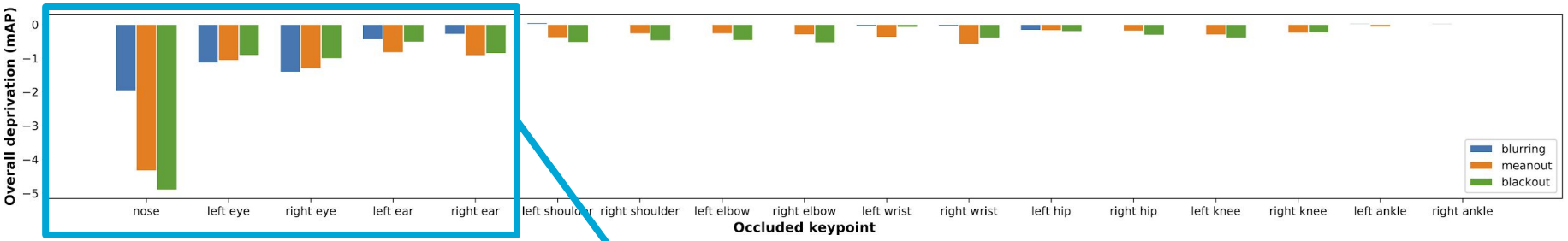
Occluded image
(blackout nose)



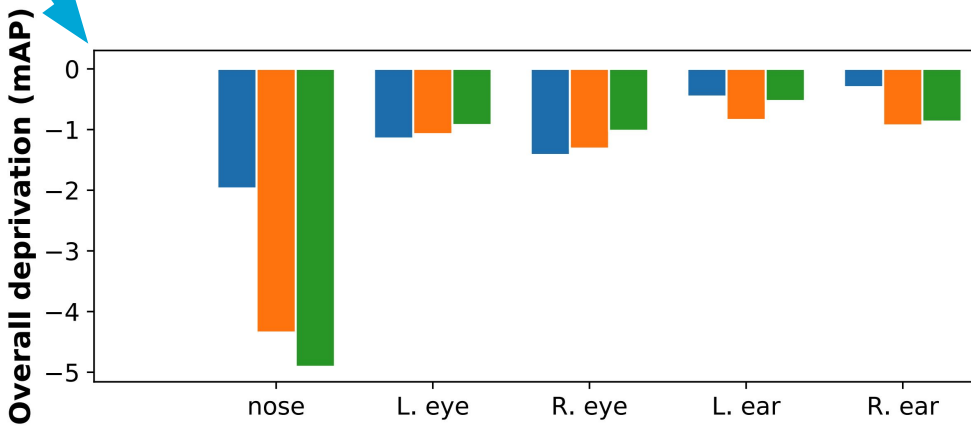
Introduced occlusion

shifted face keypoint

Sensitivity to keypoint occlusion



Head keypoints are most vulnerable.



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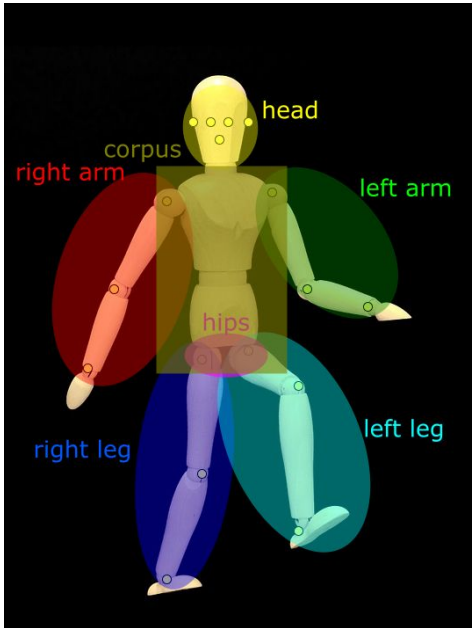
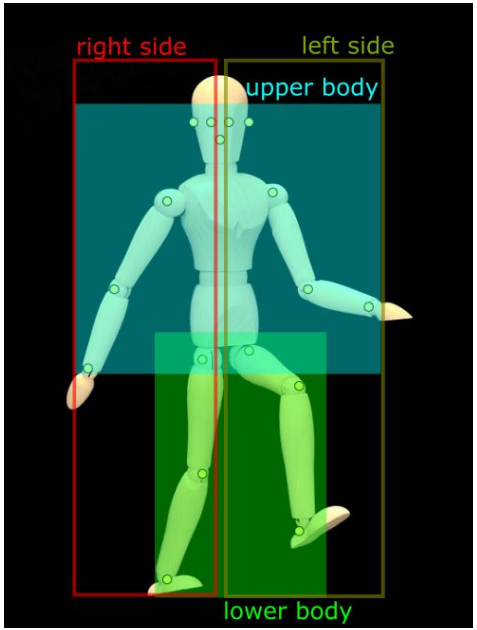
Part attacks

Occlusion attacks - part level

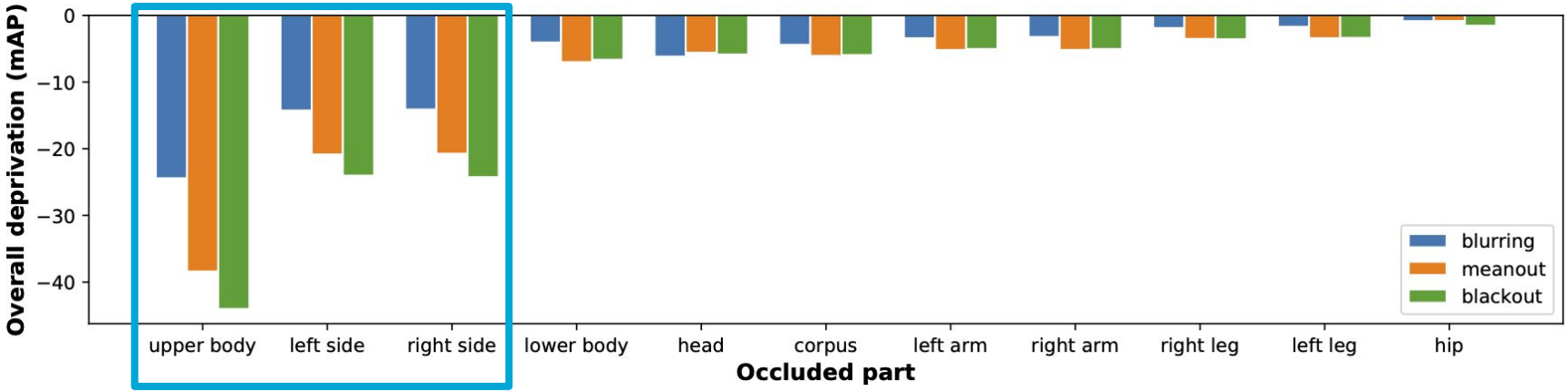




Affected area is a minimum box covering all keypoints of part.

Sensitivity to part occlusion

Parts with more keypoints occluded have largest loss in performance.



How can we mitigate occlusion problems?

Occlusion augmentations - Blurring

Original image

Blurring (K)

Blurring (P)

Occlusion augmentations - Cutout

Original image

Cutout (K)

Cutout (P)

Occlusion augmentations - PartMix

Original image

PartMix

Another left arm pasted instead of right leg

Do occlusion augmentation help?

Investigated approaches

Evaluation and experiments on two most popular datasets:

- **COCO**
- MPII

Investigated approaches:

- **HRNet**
- SimpleBaseline
- HigherHRNet

Do keypoint level augmentations help?

- Smaller step in improvement after every extra augmentation

Augmentation	p	mAP
Baseline	-	65.3
Baseline (flip, rot, scale)	-	73.9
Baseline (flip, rot, scale, half body)	-	74.3
Blurring (K)	**0.5**	**74.5**
Cutout (K)	**0.5**	**74.5**

Do keypoint level augmentations help?

- Smaller step in improvement after every extra augmentation
- Keypoint augmentations improves the performance slightly.

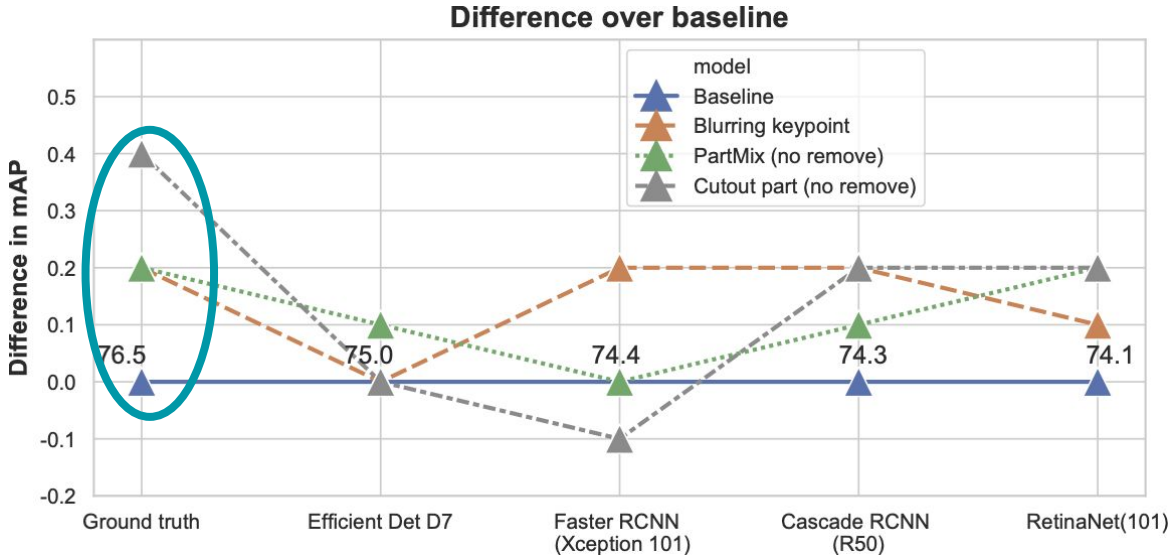
Augmentation	p	mAP
Baseline	-	65.3
Baseline (flip, rot, scale)	-	73.9
Baseline (flip, rot, scale, half body)	-	74.3
Blurring (K)	**0.5**	**74.5**
Cutout (K)	**0.5**	**74.5**

Do part level augmentations help?

Slight improvement for Cutout (+ 0.2%) and PartMix (+ 0.1%).

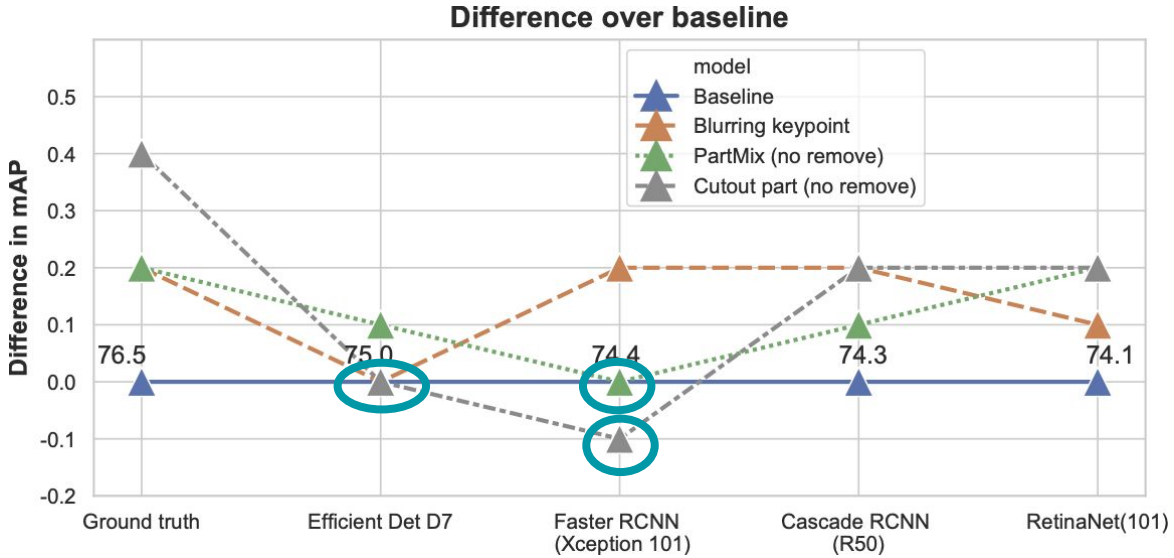
Augmentation	p	mAP
Baseline	-	65.3
Baseline (flip, rot, scale)	-	73.9
Baseline (flip, rot, scale, half body)	-	74.3
Blurring (P)	0.5	74.1
Cutout (P)	**0.5**	**74.5**
PartMix	**0.5**	**74.4**

How does detector influences results?



- Using ground truth bounding boxes shows largest improvement.

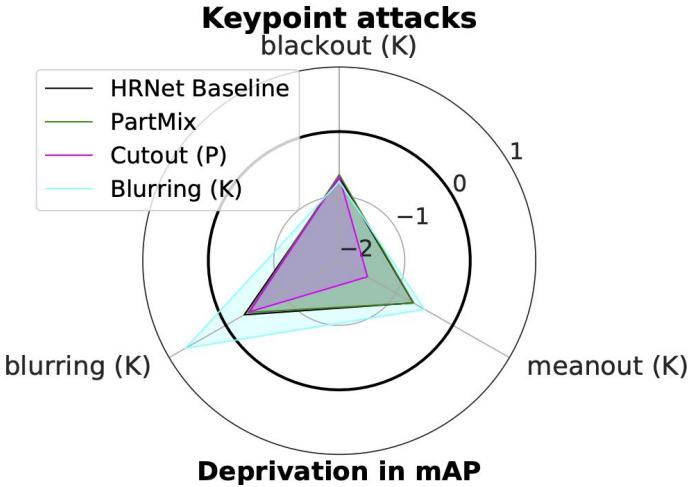
How does detector influences results?

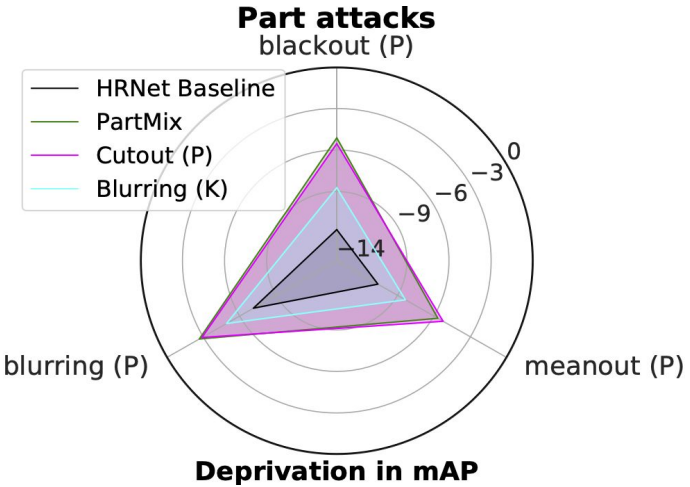


- Using ground truth bounding boxes shows largest improvement.
- Proposed augmentations do not always improve results.

Do occlusion augmentations bring robustness?

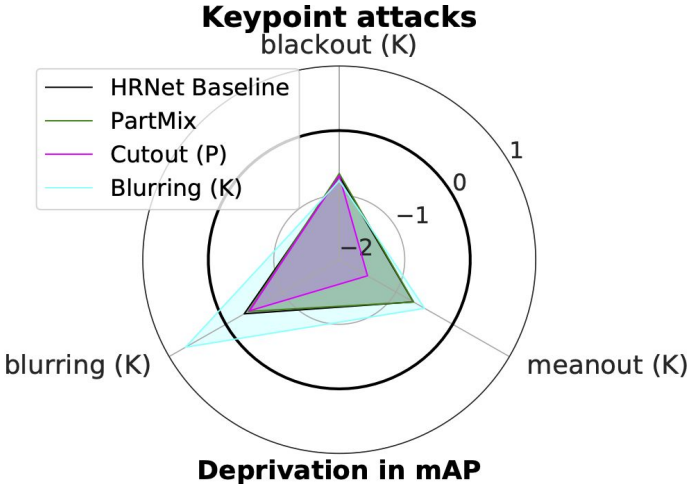
Robustness against occlusion attacks

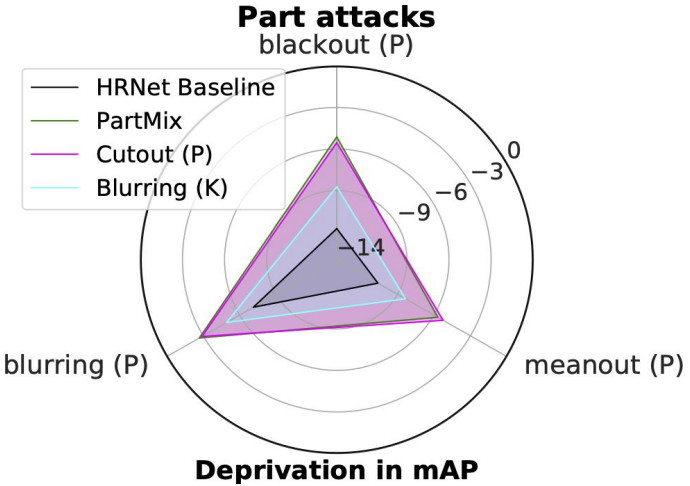




- Proposed augmentations make model slightly more robust.

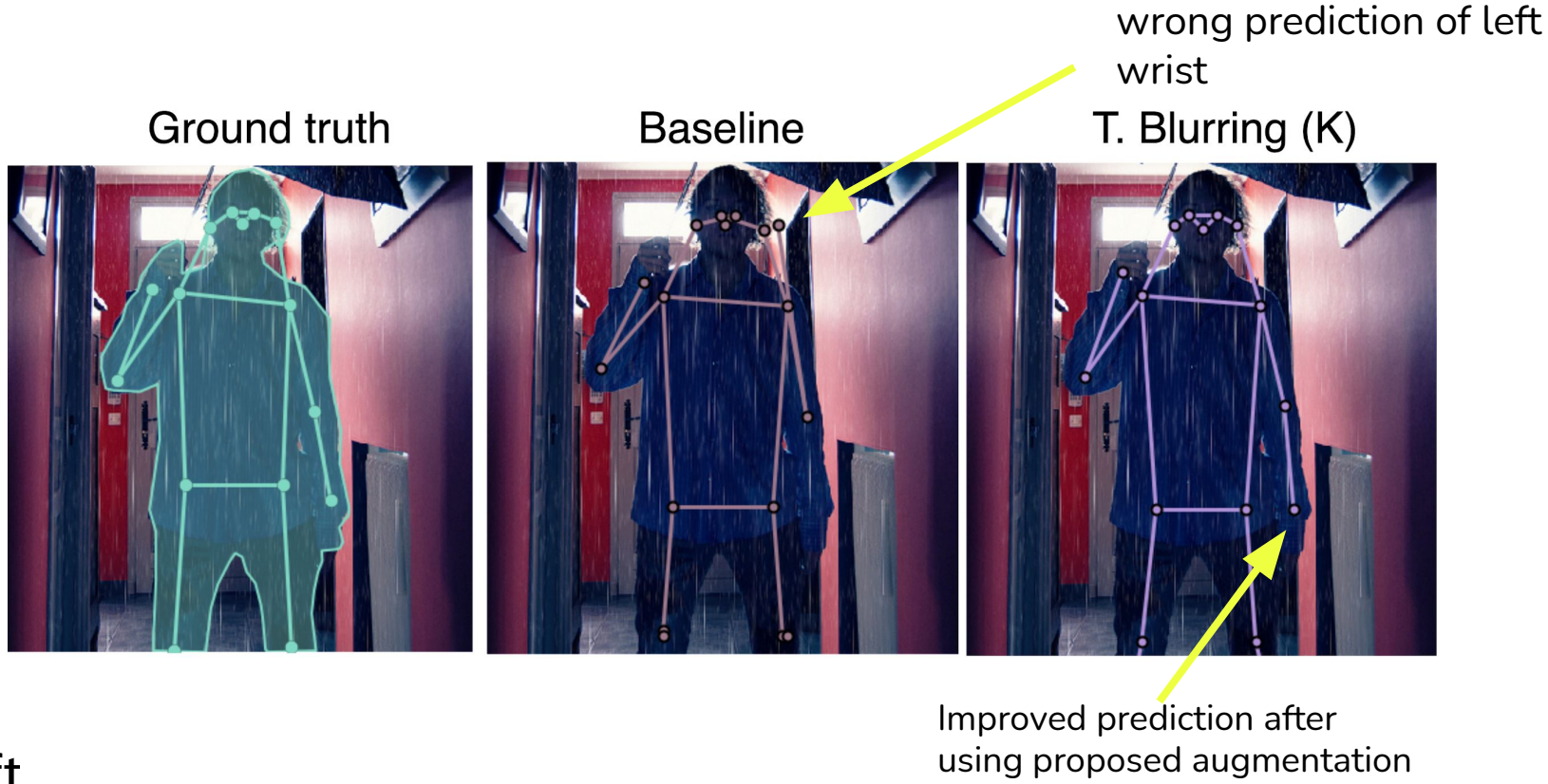
Robustness against occlusion attacks





- Proposed augmentations make model slightly more robust.
- Data augmentation still **do not solve** the occlusion problem.

Qualitative examples - good

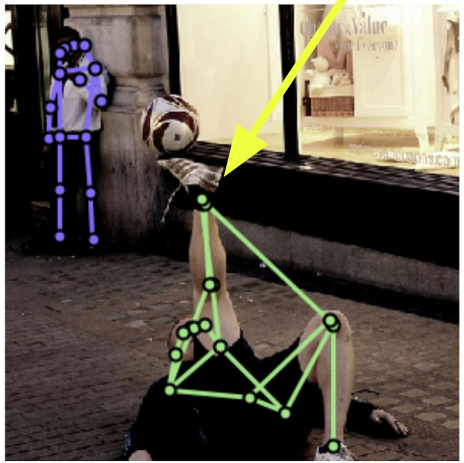


Qualitative examples - no improvement

Wrong prediction for both baseline and proposed augmentation.

Ground truth

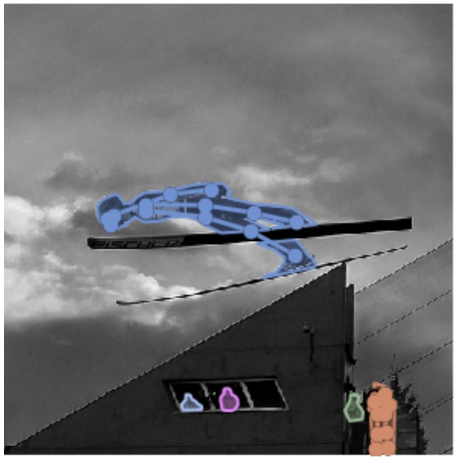
Baseline



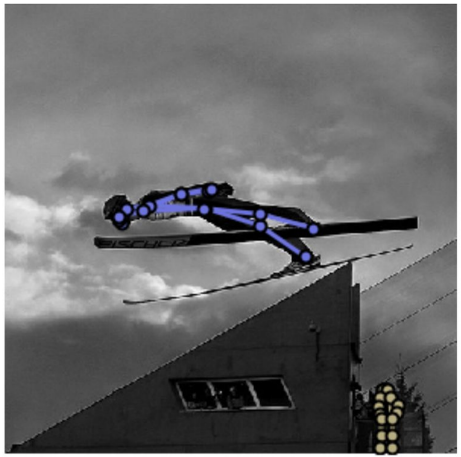
T. Blurring (K)

Qualitative examples - deprivation

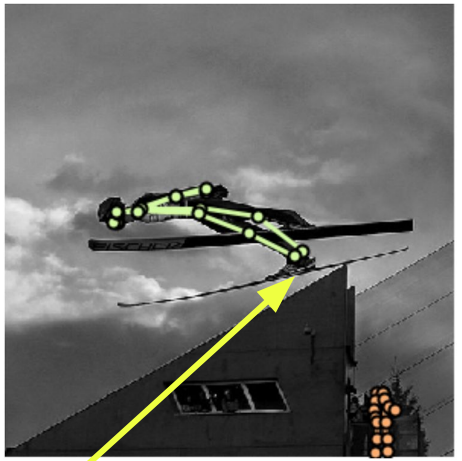
Ground truth



Baseline



T. Blurring (K)



Wrong annotation of left ankle after training with proposed augmentation

Conclusion

- For COCO dataset head keypoints are vulnerable to keypoint occlusion attacks.

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Conclusion

- For COCO dataset head keypoints are vulnerable to keypoint occlusion attacks.
- Occlusions of parts with more keypoints affect overall performance the most.
- With all the bells and whistles current and proposed methods do not bring significant improvement.
- Person detectors influence a lot results of top down approaches, varying boost given by augmentation

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Thank you for your attention!

Official repository:
https://github.com/rpytel1/occlusion-vs-data-augmentations

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