CP-VTON+: Clothing Shape and Texture Preserving Image-Based Virtual Try-On

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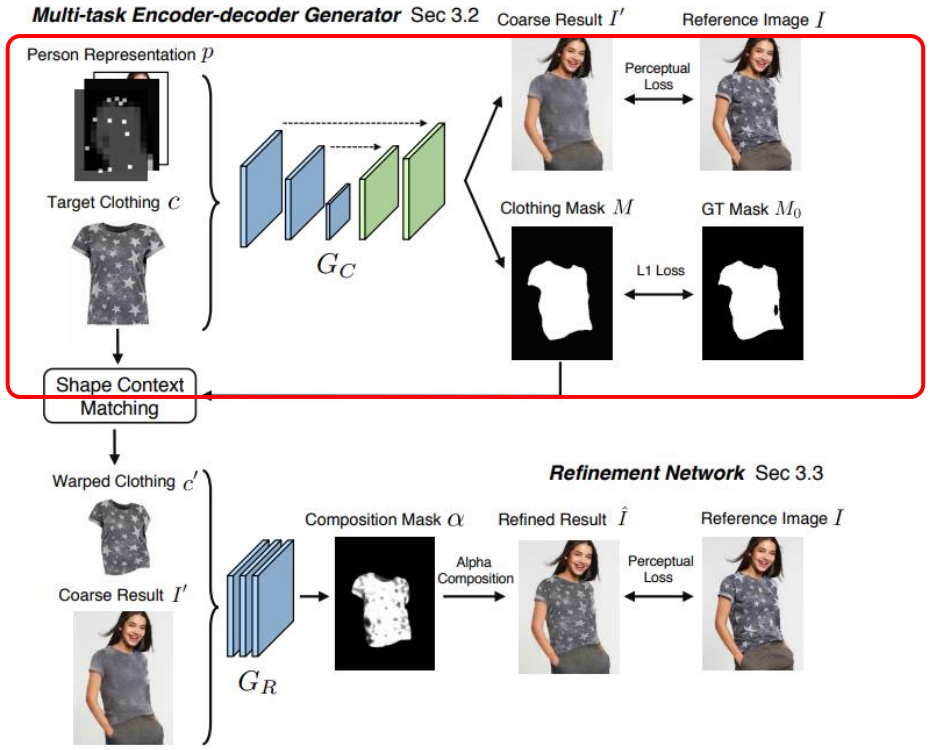
Virtual try on

- Retain body shape and pose
- Reserve characteristics of target clothes
- Eliminate old clothes and replace with target clothes
- Retain non-relevant clothes

VITON

- Coarse-to-fine approach, using two-stage network
- Generator Stage
  - encoder-decoder generator
  - coarse synthesized image result I’
- Refinement Stage
  - generate warped image c’ using TPS
  - refine using c’ and I’



VITON: An Image-based Virtual Try-on Network, Xintong Han et al. CVPR 2018

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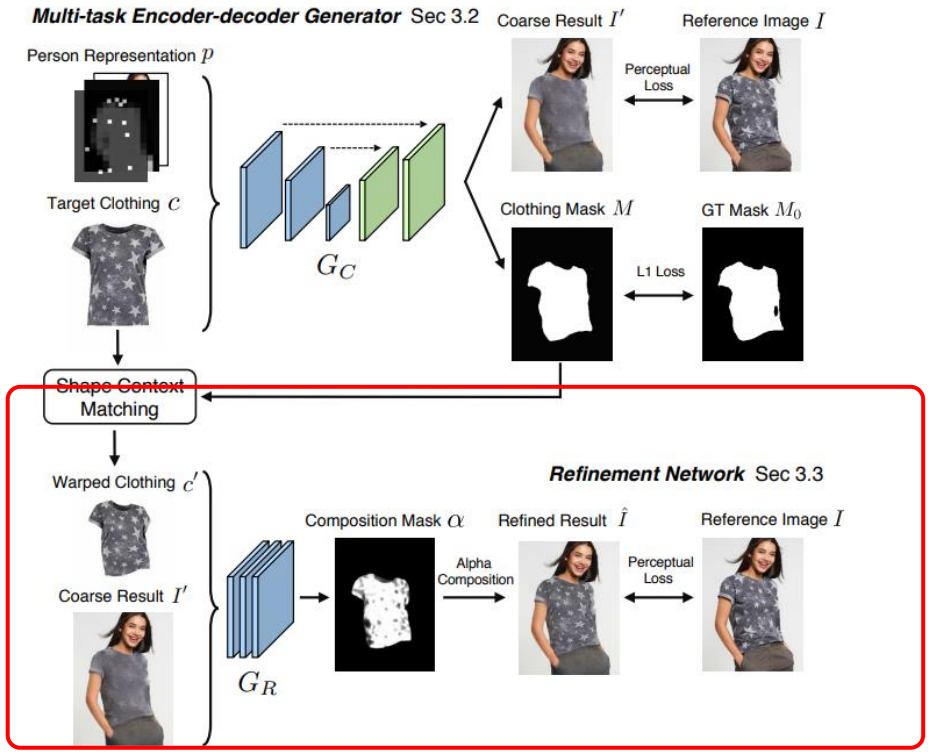


VITON: An Image-based Virtual Try-on Network, Xintong Han et al. CVPR 2018

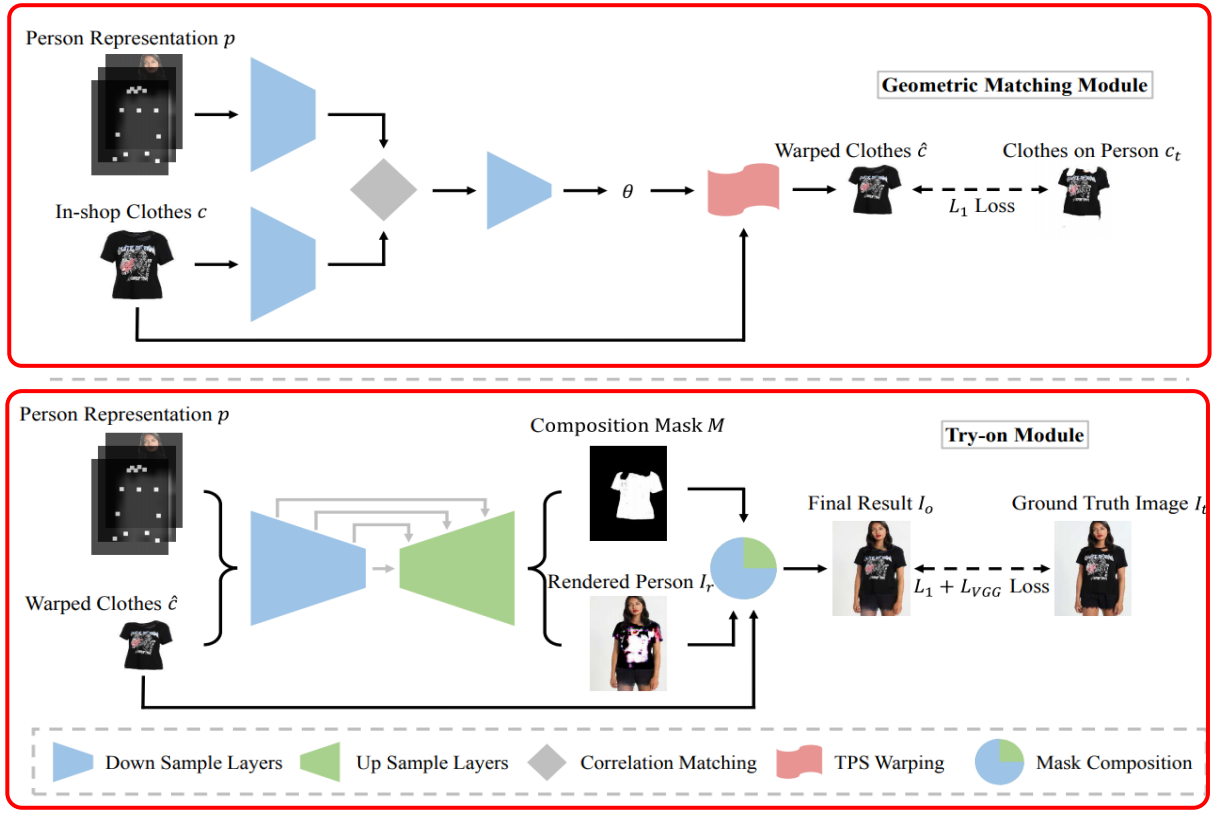
VITON

- Coarse-to-fine approach, using two-stage network
- Problem
  - Warping is vulnerable to mask, blurry in rich details

VITON: An Image-based Virtual Try-on Network, Xintong Han et al. CVPR 2018

CP-VTON

- Preserving the characteristics of clothes
- Geometric Matching Module (GMM)
  - estimating transformation parameters (TPS)
  - generate warped image ĉ
- Try-On Module (TOM)
  - A network to estimate M and coarse person image
  - generate final try on image Ir
  - fuse M, Ir and ĉ



Toward Characteristic-Preserving Image-based Virtual Try-On Network, Bochao Wang et al., ECCV 2018

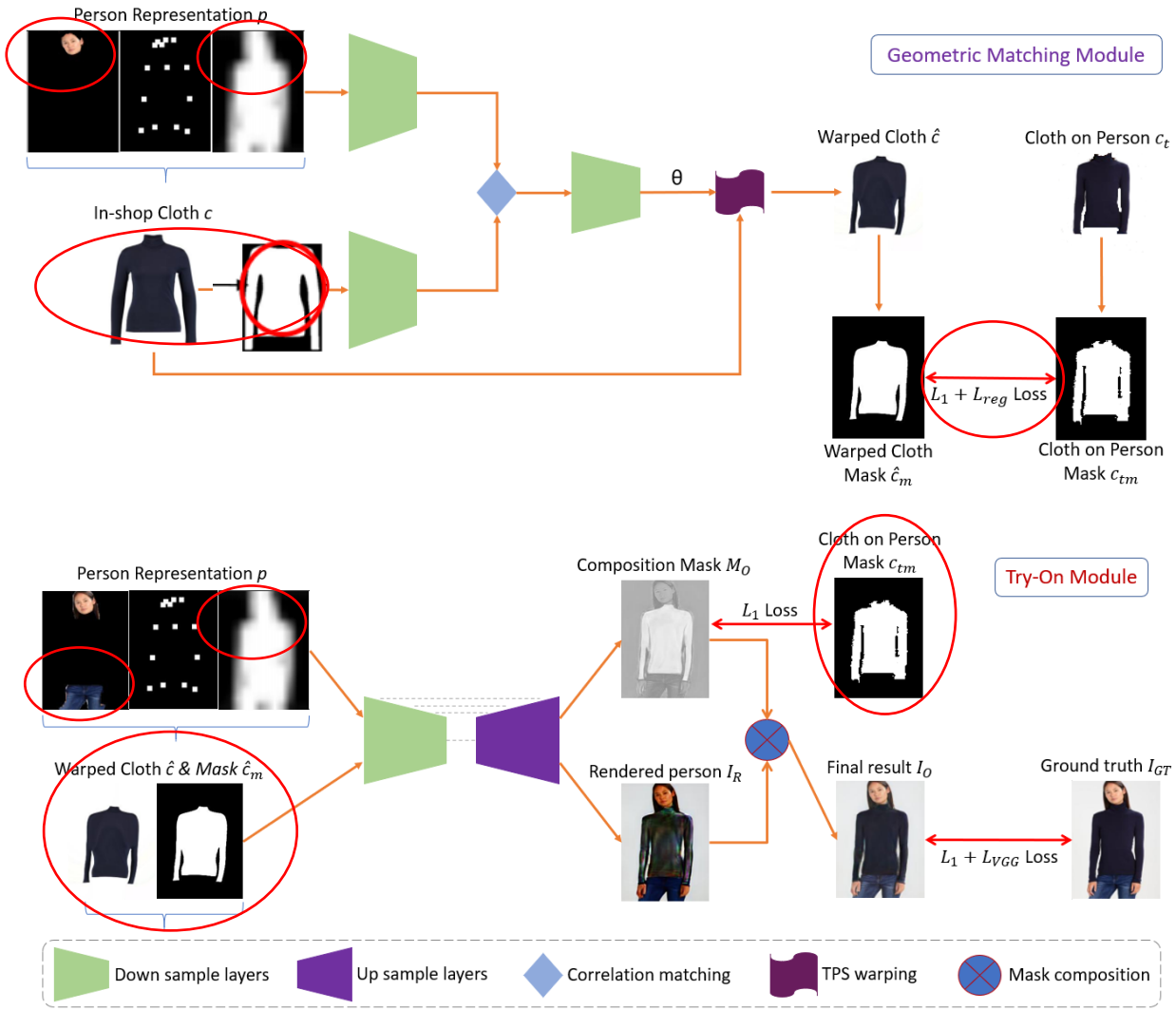
CPVTON+

Add skin label to VITON dataset

Using target cloth mask

Add un-upper cloth

Add warped cloth mask



Add regularization loss

Supervised ground truth

Clothing Warping Stage: Adding skin label

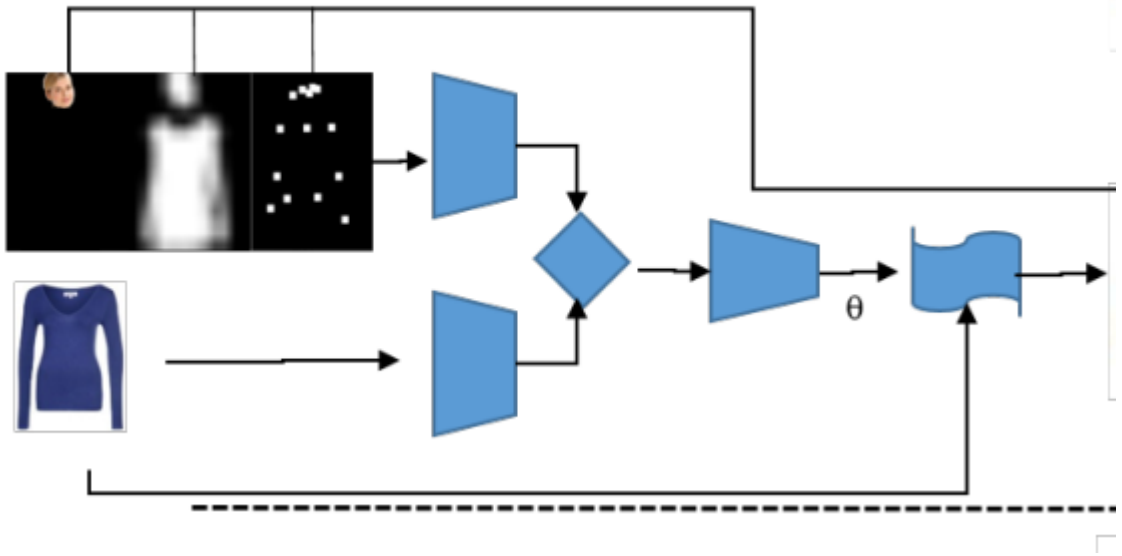
- Neck and bare chest area → wrongly labeled as background
- Improvement:
  - Add new label ‘skin’

Reference image | Human parsing From VITON dataset | Body shape In CPVTON | Update human parsing With skin label | Body shape In CPVTON+

Clothing Warping Stage: using of cloth mask

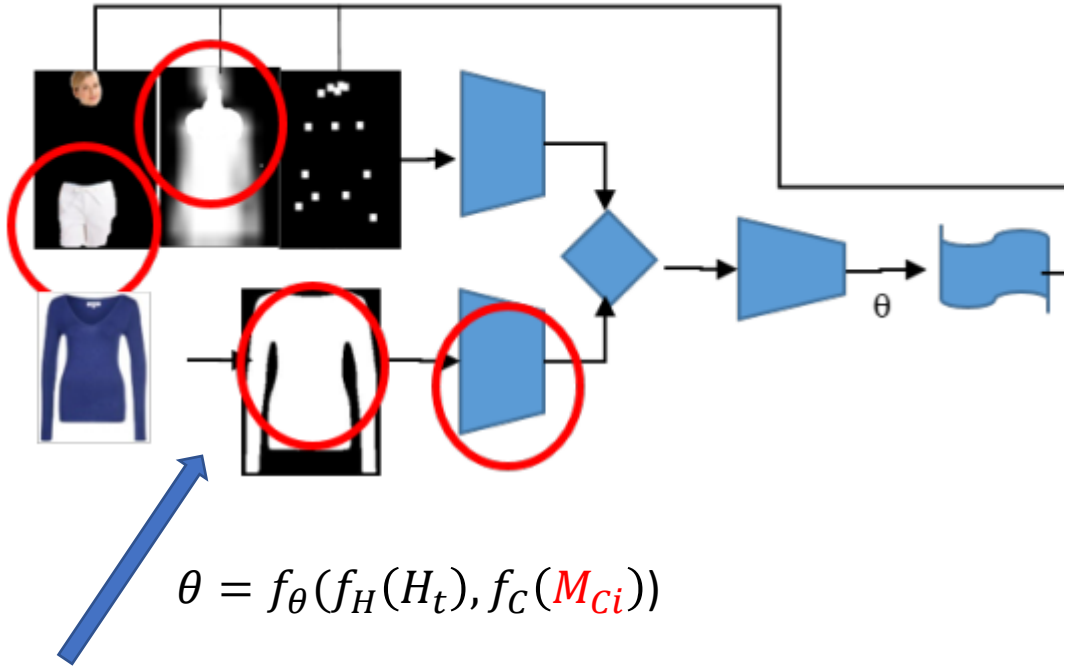
- Colored cloth → Cloth mask

CP-VTON



$$\theta = f_\theta(f_H(H_t), f_C(C_i))$$

CP-VTON+



$$\theta = f_\theta(f_H(H_t), f_C(M_{Ci}))$$

Clothing Warping Stage: TPS parameters regularization

- Reveal that warped clothing is often severely distorted. →Add regularization on the TPS parameters.

$$L_{GMM}^{CP\_VTON+} = \lambda_1 . L1\left(C_{warped}, I_{Ct}\right) + \lambda_{reg} . L_{reg}$$

$$L_{reg}\left(G_x, G_y\right) = \sum_{i=-1,1} \sum_x \sum_y |G_x(x+i, y) - G_x(x, y)| + \sum_{j=-1,1} \sum_x \sum_y |G_x(x, y+j) - G_x(x, y)|$$

Blending Stage: Retain un-upper clothes area

Reference image

CPVTON
head only input

CPVTON result

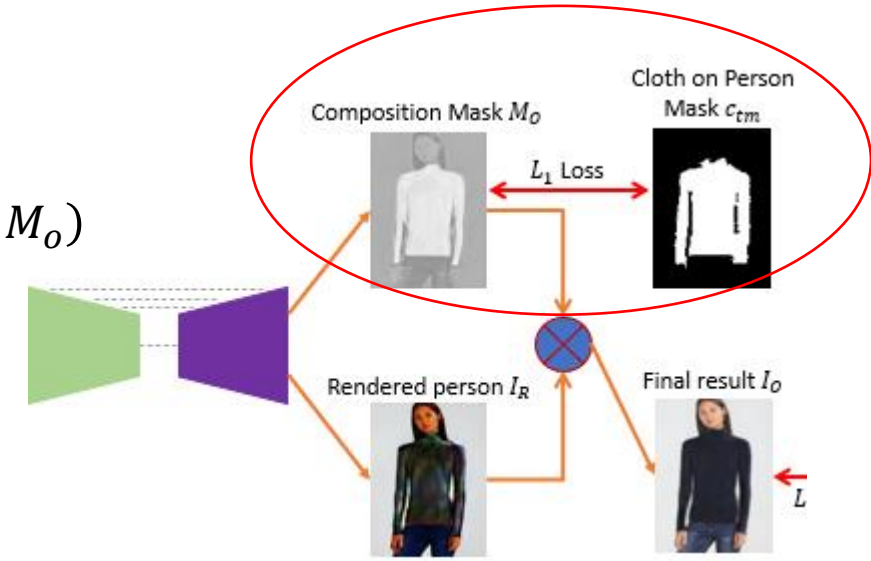
CPVTON+ up-upper
clothes area input

CPVTON+

Blending Stage: Supervised ground truth mask

$$L_{TOM}^{CP\_VTON} = \lambda_1 . L1(I_0 - I_{GT}) + \lambda_{VGG} . LVGG(I_0, I_{GT}) + \lambda_{mask} . L1(1, M_o)$$

$$L_{TOM}^{CP\_VTON+} = \lambda_1 . L1(I_0 - I_{GT}) + \lambda_{VGG} . LVGG(I_0, I_{GT}) + \lambda_{mask} . L1(M_{GT}, M_o)$$



Inshop cloth

CP-VTON warped cloth and composition mask

CP-VTON+ warped cloth and composition mask

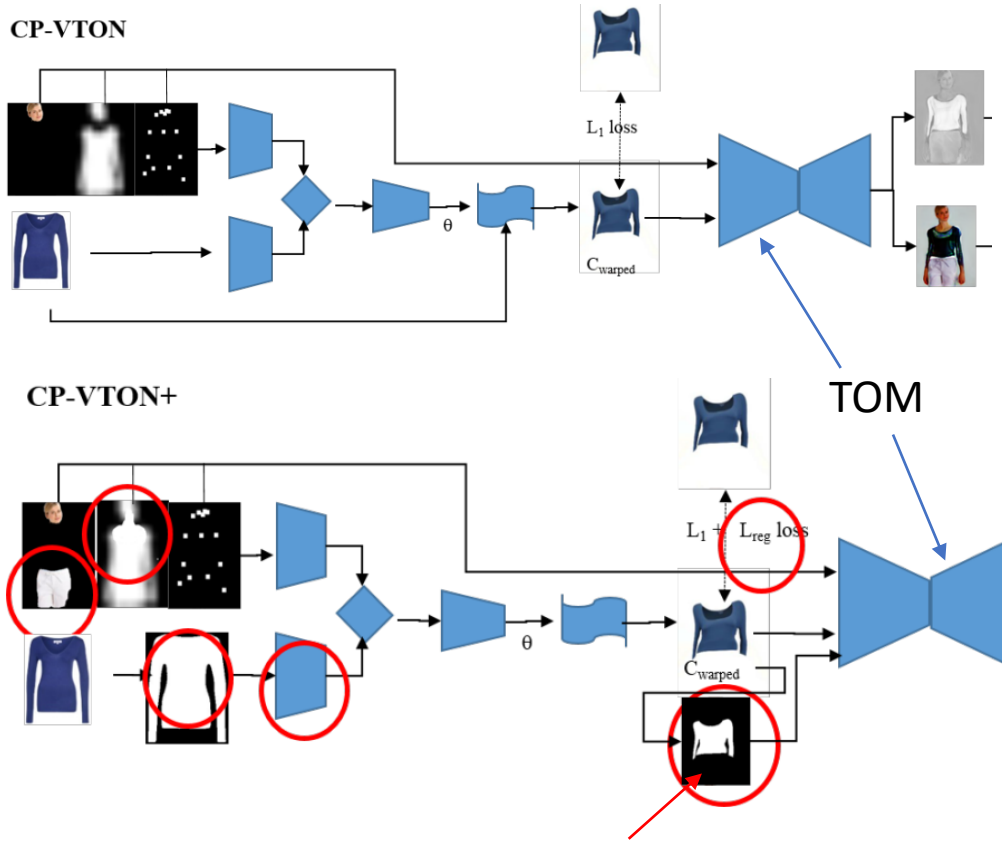
Blending Stage: improve background color inshop clothes

- TOM could not recognize the white cloth area.

Inshop cloth

CP-VTON warped cloth
and
composition mask

CP-VTON+ warped cloth
and
composition mask



Add warped cloth mask to input of TOM

Experiments and Results

Method	Warped	Blended		
	(IoU)	SSIM	LPIPS	IS (mean ± std.)
CP-VTON[4]	0.7898	0.7798	0.1397	2.7809 ± 0.0594
CP-VTON+ (w/o GMM regularization & mask loss)	0.7602	0.8076	0.1263	3.0735 ± 0.0531
CP-VTON+ (w/o GMM mask loss)	0.7920	0.8077	0.1231	**3.1312 ± 0.0837**
CP-VTON+ (Ours)	**0.8425**	**0.8163**	**0.1144**	3.1048 ± 0.1068

Ablation Study

Reference image | Inshop cloth | CPVTON | Corrected human representation | With L_{reg} Added mask | Add skin label in GMM

Discussions

- 2D transformation can not handle strong 3D deformations.
- Better human parsing is crucial for better try on results

Figure 4. Failures of our CP-VTON+

Conclusion

- Proposed a refined image based VTON system, CPVTON+
- Solving issues in previous approaches:
  - Errors in human representation and dataset
  - Network design
  - Loose cost function
- Future work:
  - 3D reconstruction would be use for handle strongly clothing deformations

Project site

- https://minar09.github.io/cpvtonplus/
- https://github.com/minar09/cp-vton-plus

References

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- [6] Richard Zhang, Phillip Isola, Alexei A Efros, Eli Shechtman, and Oliver Wang. The unreasonable effectiveness of deep features as a perceptual metric. In *CVPR*, pages 586–595, 2018. 3, 4