Recovering Geometric Information with Learned Texture Perturbations

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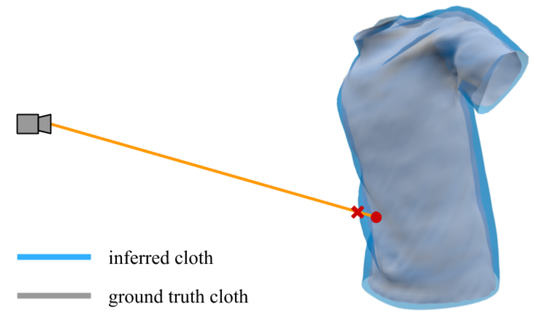
Motivation

- Cloth mesh generated by data-driven methods often lacks high frequency details.
- Propose Texture Sliding which can perturb texture coordinate so that the rendered cloth mesh appears to match the ground truth.
- Use neural network to predict Texture Sliding, and reconstruct 3D high frequency cloth mesh from two camera views of Texture Sliding.

Ground Truth Inferred

Dataset Generation



Shoot a camera ray to each inferred cloth vertex, and find the barycentric interpolation of texture coordinate of intersection point of ground truth mesh.

Inferred Texture Sliding Ground Truth

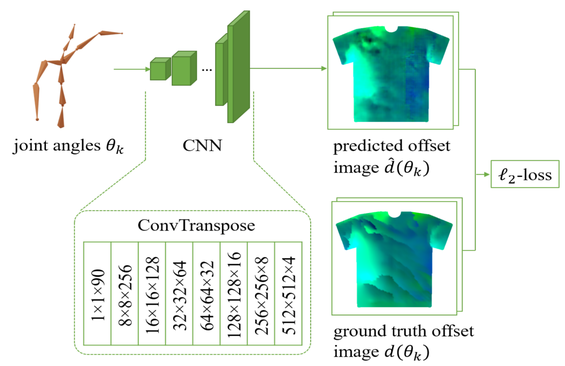
ML Models

- Input: skeleton pose θ
- Output: texture coordinate displacement $d(\theta)$
- Support Vector Regression (SVR) using ε-insensitive per-vertex loss and Gaussian kernel

$$\mathcal{L} = \sum_{\theta_k} \begin{cases} 0, & \text{if } \|d(\theta_k) - \hat{d}(\theta_k)\|_2 \le \varepsilon \\ \|d(\theta_k) - \hat{d}(\theta_k)\|_2 - \varepsilon & \text{otherwise} \end{cases}$$

- Texture Sliding Neural Network (TSNN) using per-pixel mean squared loss

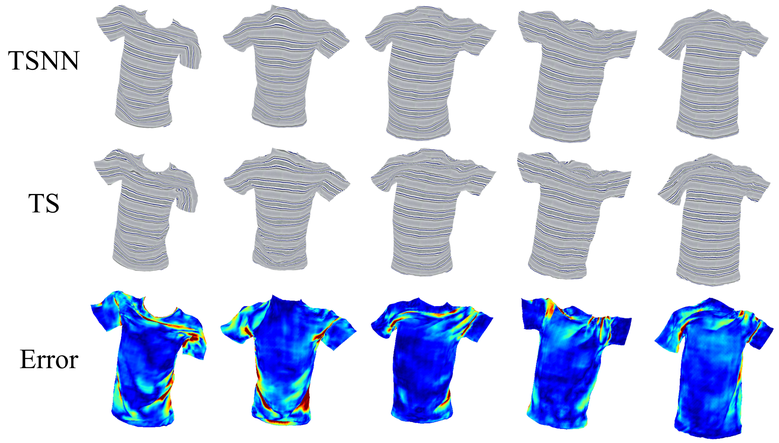
$$\mathcal{L} = \sum_{\theta_k} \left\| d(\theta_k) - \hat{d}(\theta_k) \right\|_2$$



Error Comparison

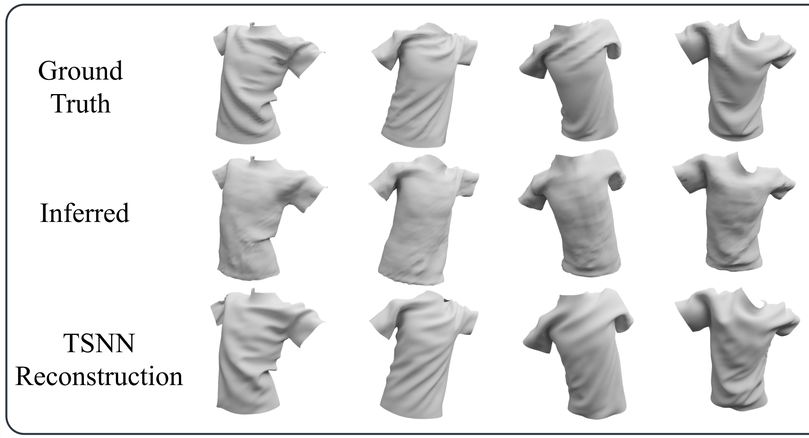
Network	SqrtMSE ($\times 10^{-3}$)
Inferred	24.871 ± 7.0613
SVR	51.848 ± 4.1035
TSNN	13.335 ± 4.2924
TSNN + subdivision	13.591 ± 4.5194

TSNN Results



- First row: TSNN prediction on inferred cloth
- Second row: Texture Sliding on inferred cloth
- Third row: Error between TSNN and ground truth cloth

3D Reconstruction



References

[1] Jin, N., Zhu, Y., Geng, Z., & Fedkiw, R. (2018). A Pixel-Based Framework for Data-Driven Clothing. arXiv preprint arXiv:1812.01677.
[2] Geng, Z., Johnson, D., & Fedkiw, R. (2019). Coercing machine learning to output physically accurate results. Journal of Computational Physics, 109099.
[3] Lahner, Z., Cremers, D., & Tung, T. (2018). Deepwrinkles: Accurate and realistic clothing modeling. In Proceedings of the European Conference on Computer Vision (ECCV) (pp. 667-684).
[4] Santesteban, I., Otaduy, M. A., & Casas, D. (2019, May). Learning-Based Animation of Clothing for Virtual Try-On. In Computer Graphics Forum (Vol. 38, No. 2, pp. 355-366).