On the Skinning of Gaussian Avatars

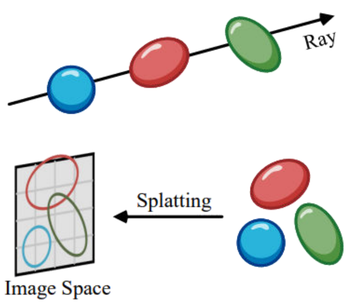
Gaussian Splats

$$G_i = \{\mu_i, q_i, \sigma_i, \alpha_i, s_i\},$$

$$S := diag(\sigma)$$
$$R := \mathcal{R}(q) \in \mathbb{SO}^3$$
$$\Sigma = RSS^T R^T$$

$$\varrho(x) = \alpha e^{\frac{1}{2}(x-\mu)\Sigma^{-1}(x-\mu)}$$

$$c = \sum_{p=0}^{M} c_p \alpha_p \prod_{q=1}^{p-1}(1 - \alpha_q)$$



Linear Blend Skinning

$$T_j^t := \begin{bmatrix} R_j^t & t_j^t \\ 0 & 1 \end{bmatrix} \in \mathbb{SE}^3, j \in [\![1, \dots, J]\!]\}.$$

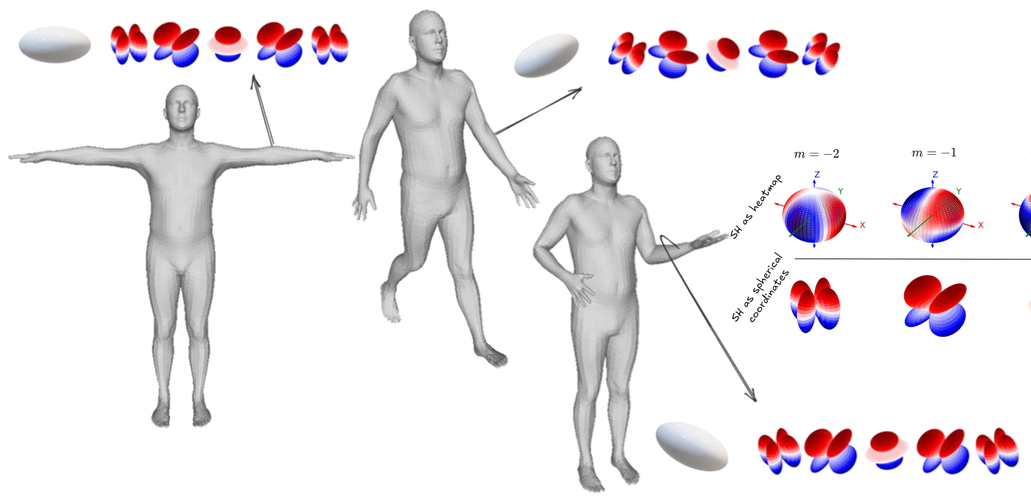
$$\mu_i^t = \mathcal{T}_i^t \mu_i, \qquad \mathcal{T}_i^t = \sum_{j=0}^{J} T_j^t w_i^j$$

$$A_i^t = \sum_{j=0}^{J} w_i^j \left(b_j^t\right)^T b_j^t$$

$$q_i^t = \bar{q}_i^t q_i$$

Non-Linear Components Skinning

$$s_{i,0:1}^t = s_{i,0:1}^t$$
$$s_{i,1:4}^t = W^1\left(\overline{R_i^t}\right) s t_{i,1:4}^t$$
$$s_{i,4:9}^t = W^2\left(\overline{R_i^t}\right) s t_{i,4:9}^t$$
$$s_{i,9:16}^t = W^3\left(\overline{R_i^t}\right) s t_{i,9:16}^t$$



Non-linear components not typically skinned

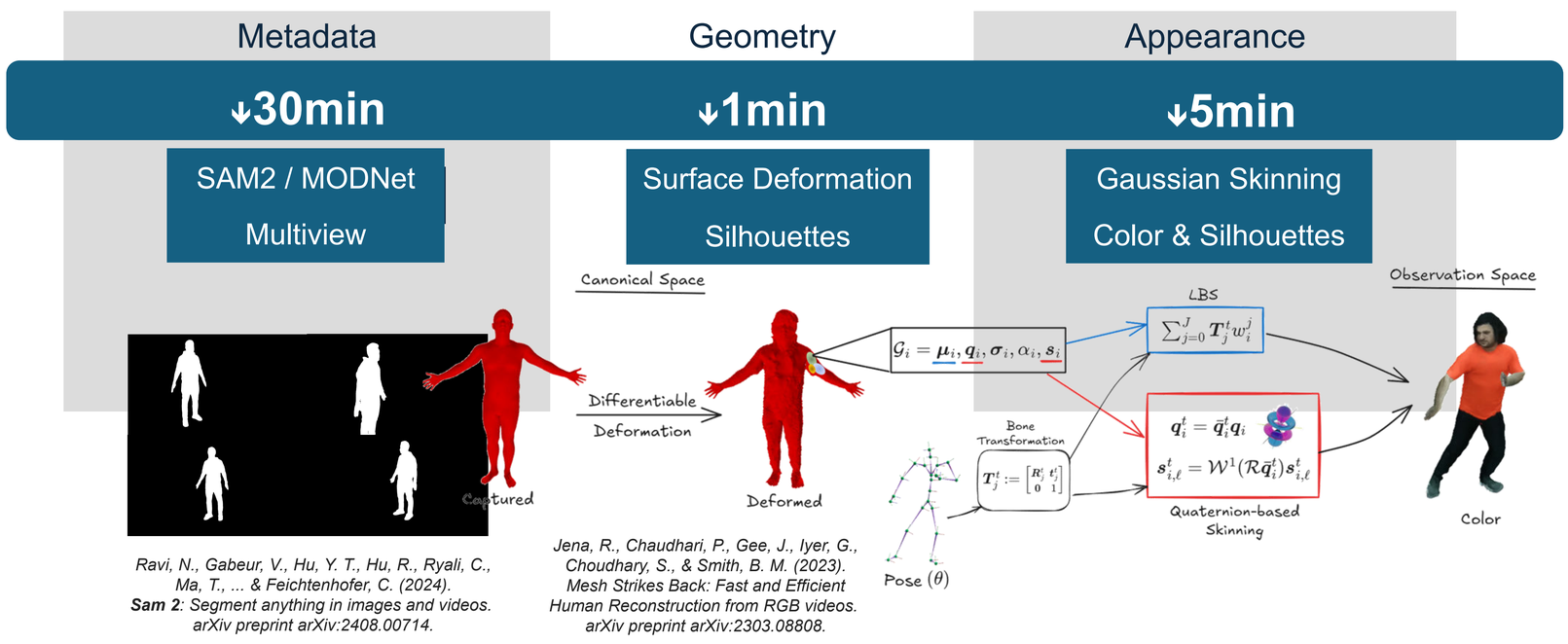
Instead:

- Neural networks predict them, or,
- Predict offsets post-LBS, or,
- Attach the Gaussians on the mesh

Skinning Gaussians

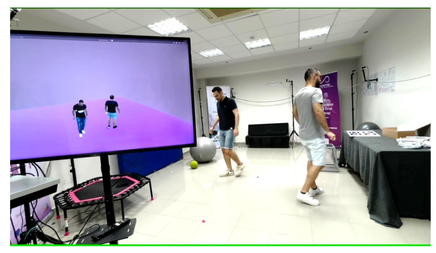
- Quaternion skinning average
- D-Wigner SH rotation

Overview

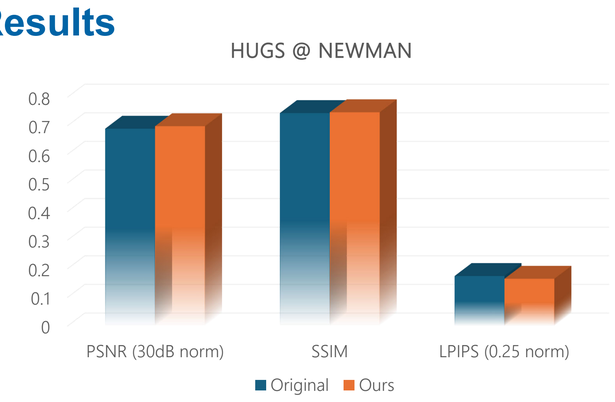


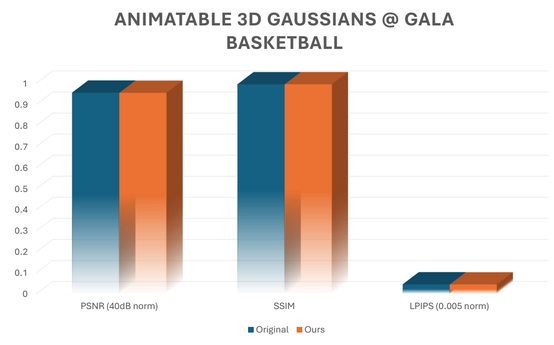
Ravi, N., Gabeur, V., Hu, Y. T., Hu, R., Ryali, C., Ma, T., ... & Feichtenhofer, C. (2024). ***Sam 2****: Segment anything in images and videos. arXiv preprint arXiv:2408.00714.*

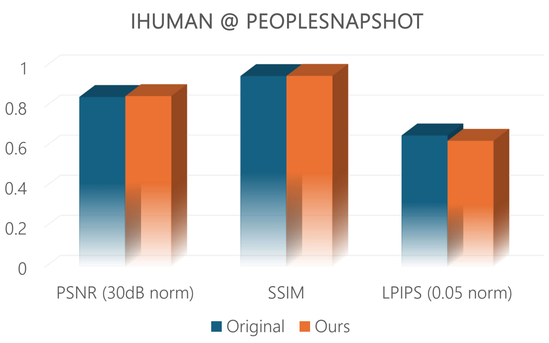
Jena, R., Chaudhari, P., Gee, J., Iyer, G., Choudhary, S., & Smith, B. M. (2023). Mesh Strikes Back: Fast and Efficient Human Reconstruction from RGB videos. arXiv preprint arXiv:2303.08808.

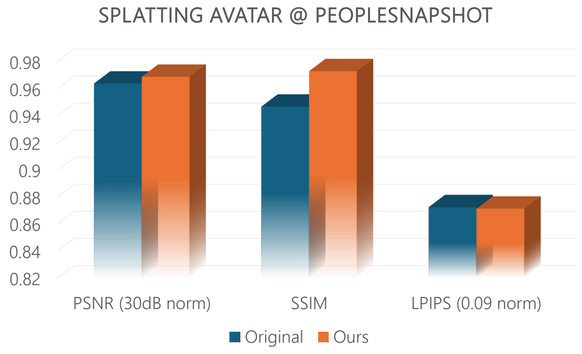


Results

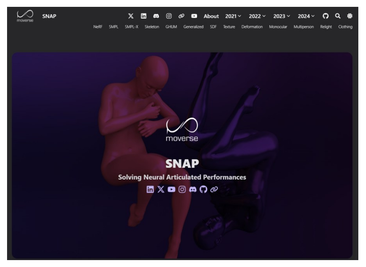








SNAP Project



https://moverseai.github.io/snap

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References (Selection)

Ravi, N., Gabeur, V., Hu, Y. T., Hu, R., Ryali, C., Ma, T., ... & Feichtenhofer, C. (2024). Sam 2: Segment anything in images and videos. arXiv preprint arXiv:2408.00714

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