NII International Internship program

Segmented Fusion

Warping method

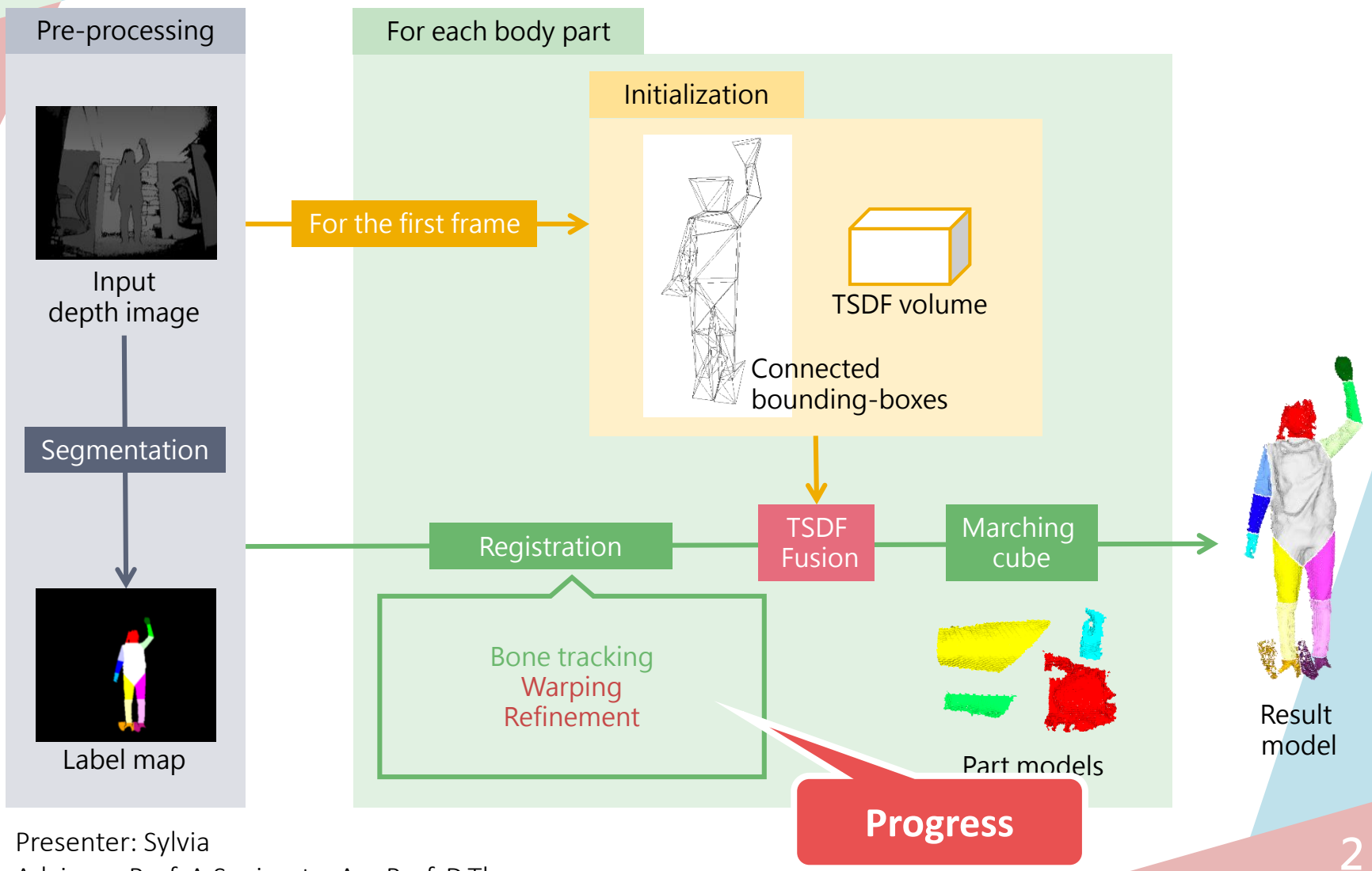
20180126

Sylvia

Advisors: Prof. A.Sugimoto

Ass.Prof. D.Thomas

Summary



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Summary

- Previously
  - Implemented dual quaternion skinning with heat weight
- Progress
  - Found the reason of the distortion when warping
    - scaling
    - Un-standard mesh in volume
  - Completed the fusion with dual quaternion blending
  - Refined the positions of bones

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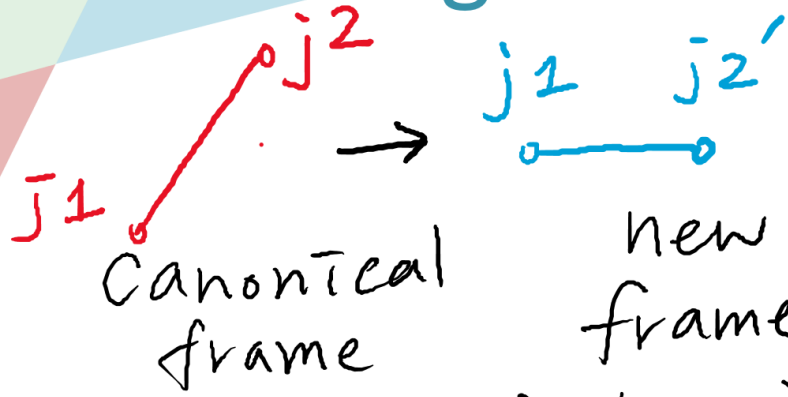
Progress

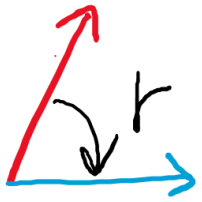
Blending function



$V1 = \overrightarrow{j1\,j2}$

$= j2 - j1$

$V2 = j2' - j1$



$T_R = R(v1, v2)$, $R(u,v)$ get the rotation matrix from vector u to vector v

$T_c = T(j1)$, $T(p)$ get the translation matrix from origin to point p

$T_h = T(j1')$

$$T = T_h T_R T_c^{-1}$$

bone's Transform matrix

$$DBQ(W) = \frac{\sum_i w_i dq_i}{\left\| \sum_i w_i dq_i \right\|}$$

$dq = DQ(T)$

$DQ(T)$ get dual quaternion of transform T

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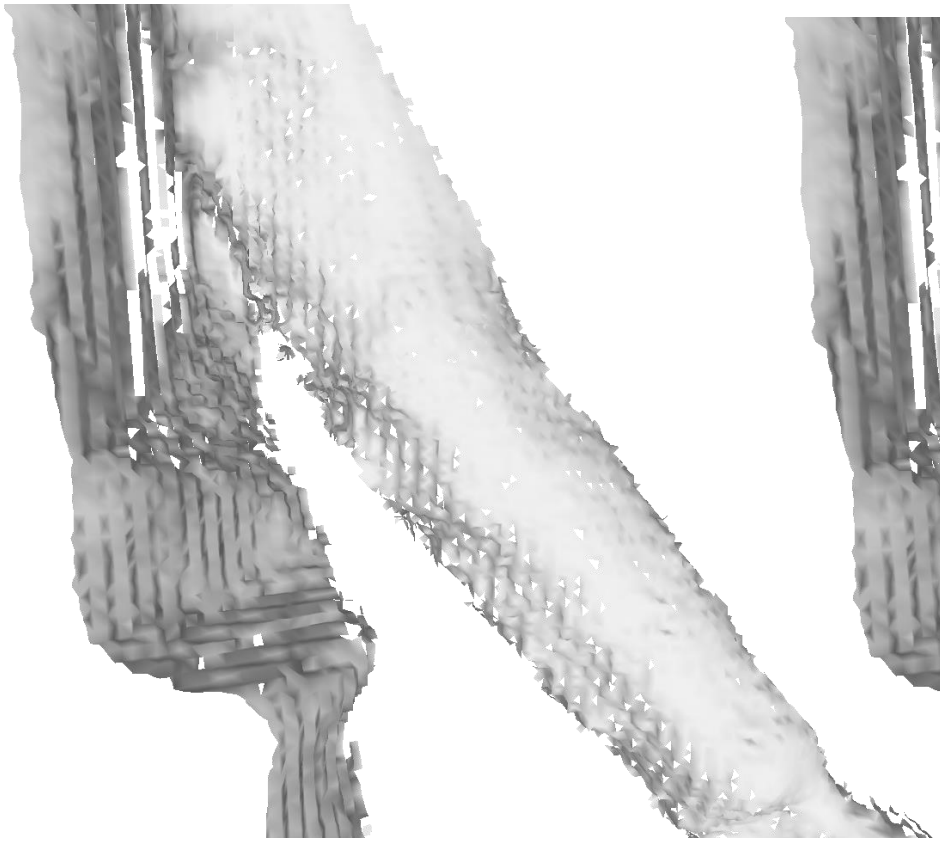
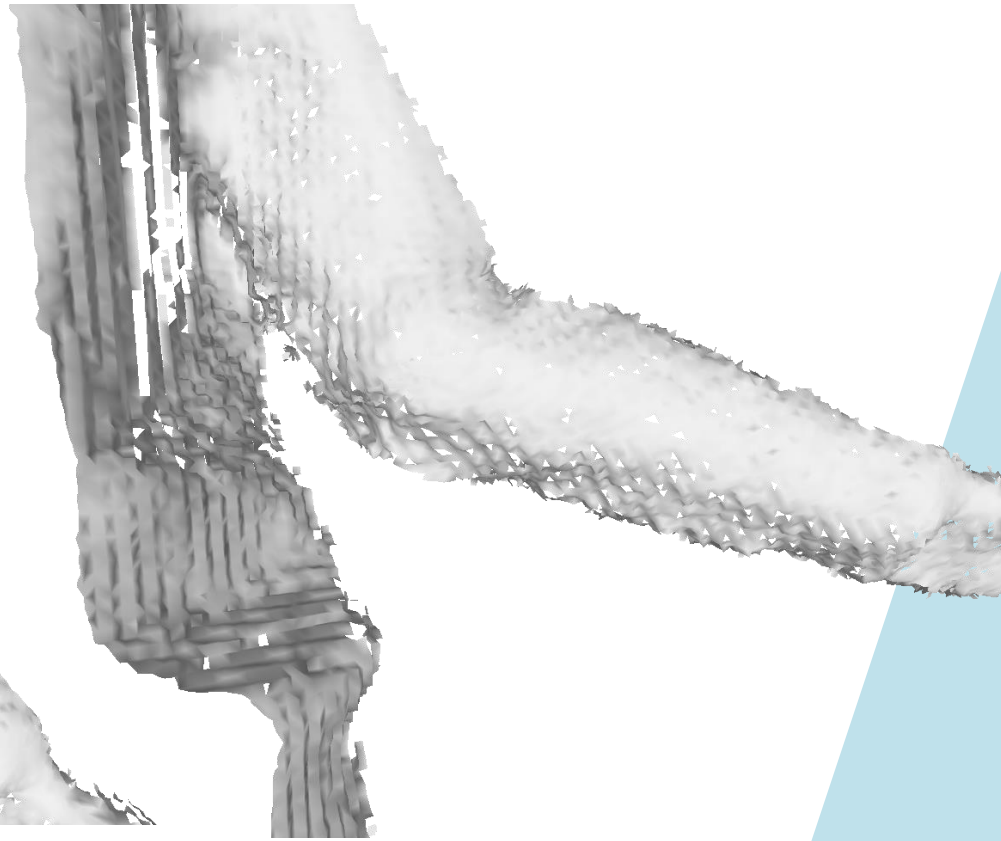
Blending results

- Use assigned rotation to warping the meshes



First frame



Second frame

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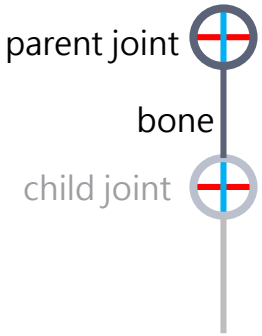
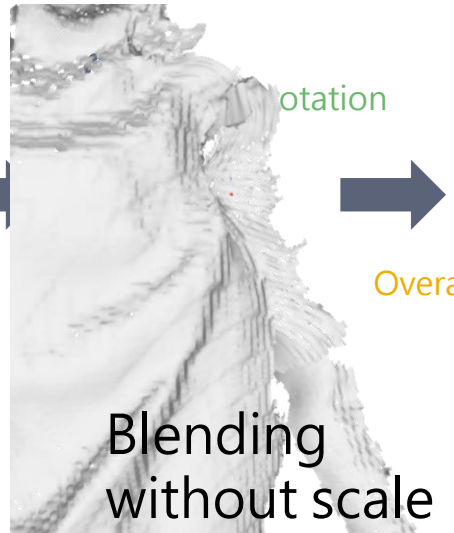
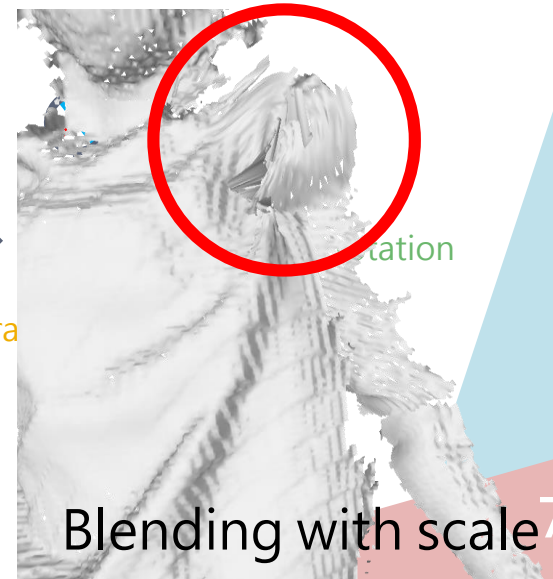
Blending with scale

- Because of the noise of the data, the length of bone is not consistent.
- Two ways to decompose the transformation into a scale component and a rigid component
- 1. apply a polar decomposition on transform matrix
- 2. put a scale component when concatenate the local joint transform matrix



Reference: http://rodolphe-vaillant.fr/?e=78





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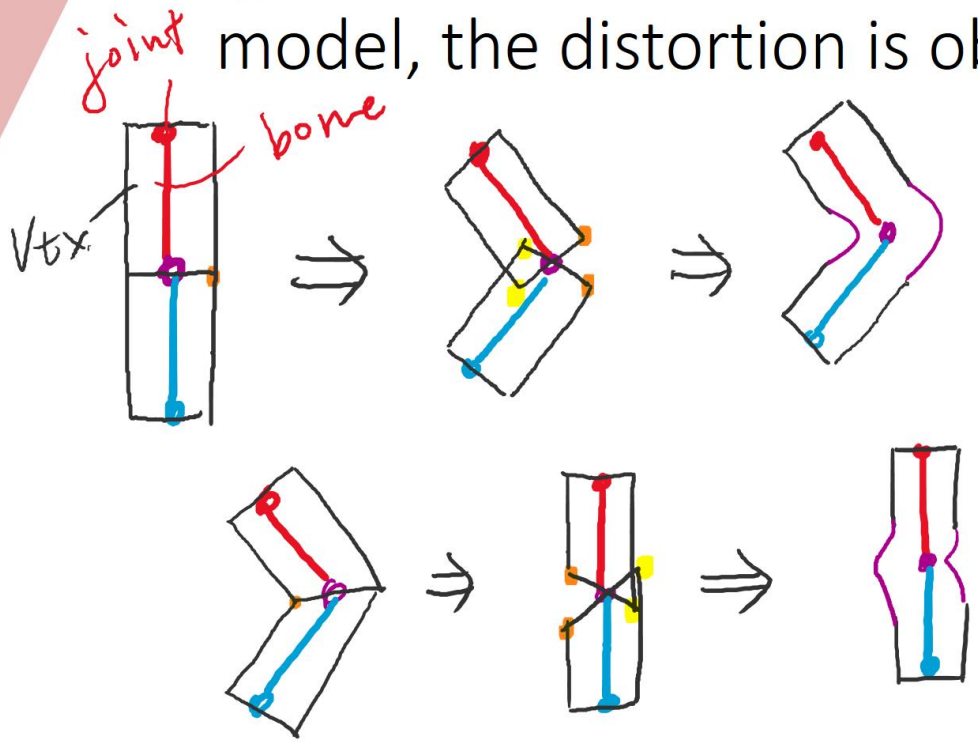
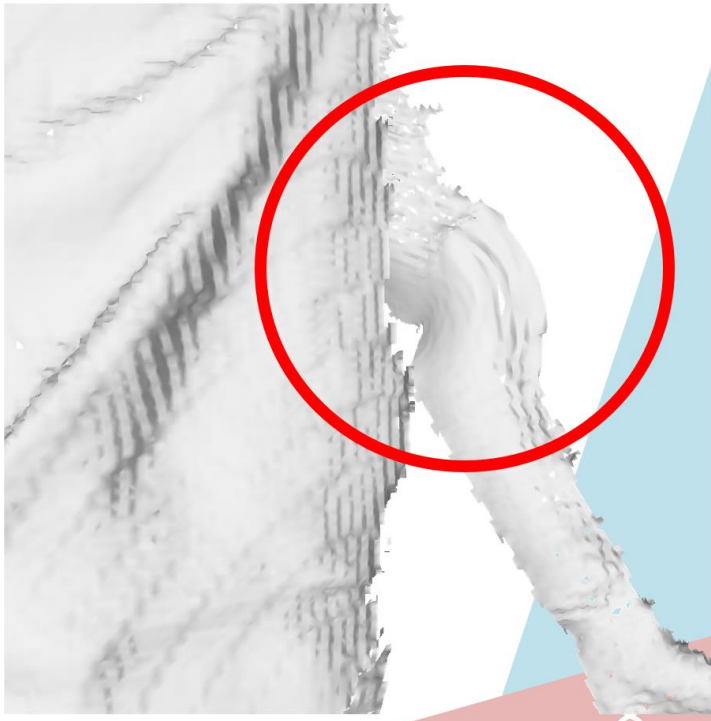
Standard meshes

- The distortion between the intersection when there is large motion is because the backward of quaternion. Since the first frame is not uniform model, the distortion is obvious.





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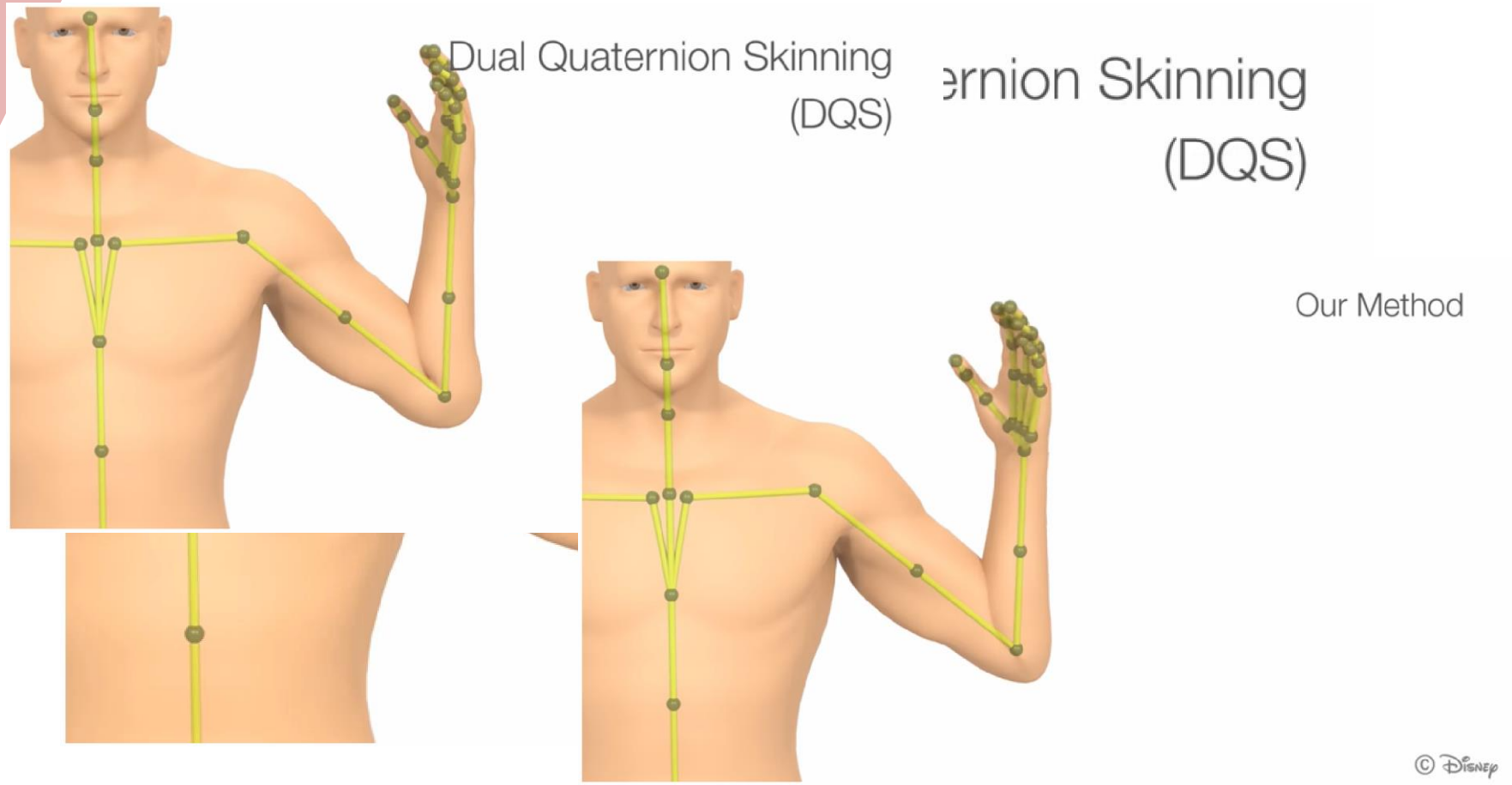
Standard meshes



Reference: Le, B. H., & Hodgins, J. K. (2016). Real-time skeletal skinning with optimized centers of rotation. *ACM Transactions on Graphics (TOG)*, *35*(4), 37.

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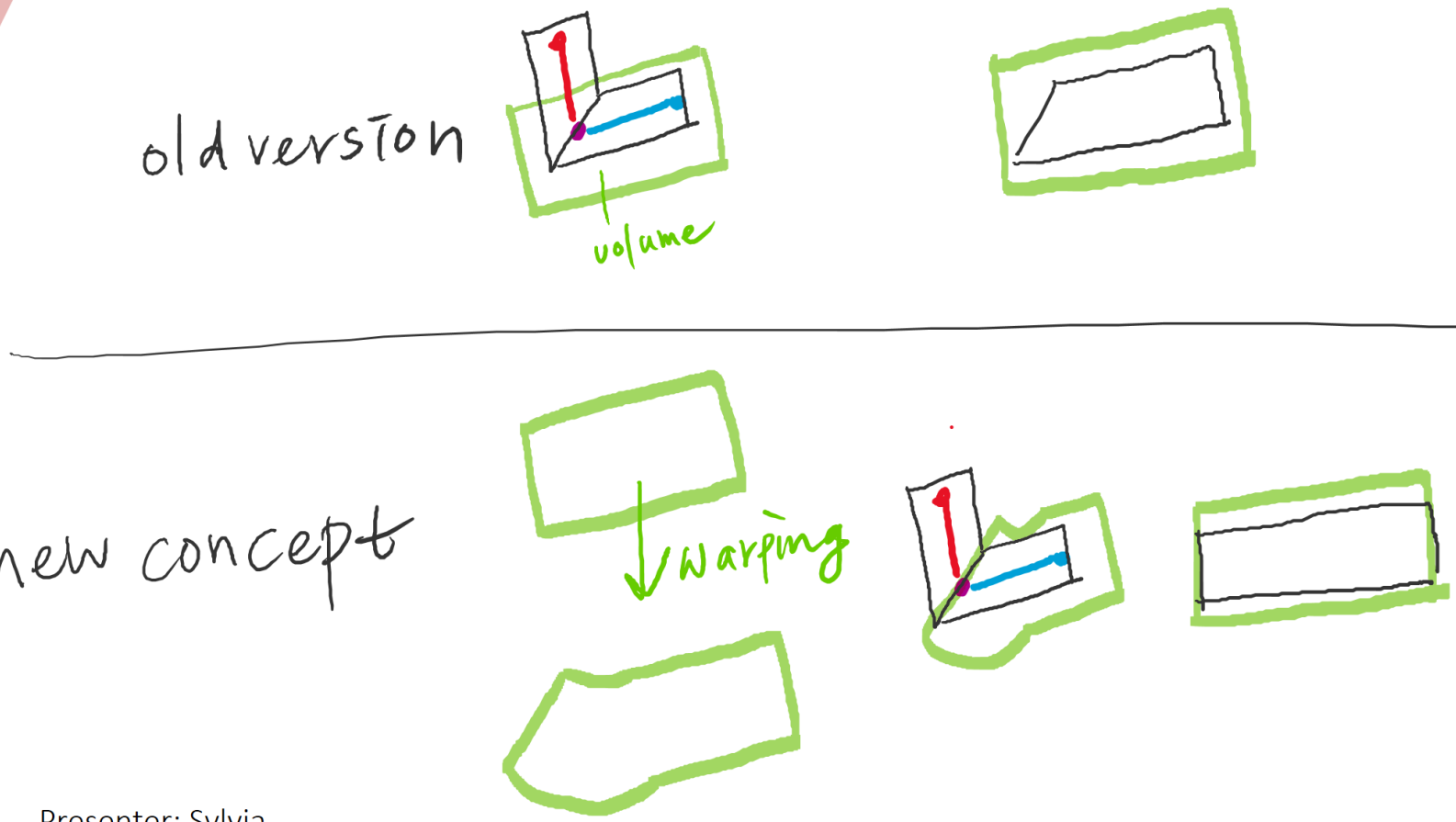
Standard meshes

- I warp the first mesh and save standard mesh in volume.



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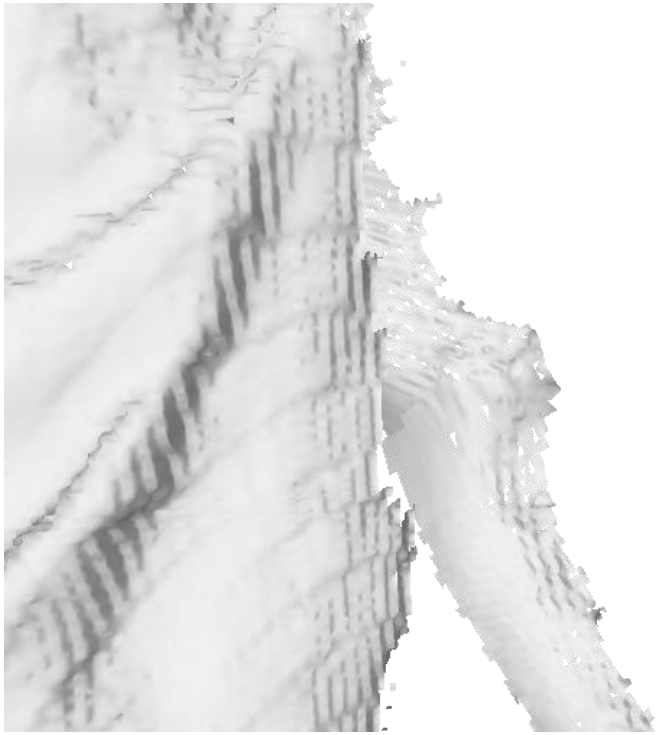
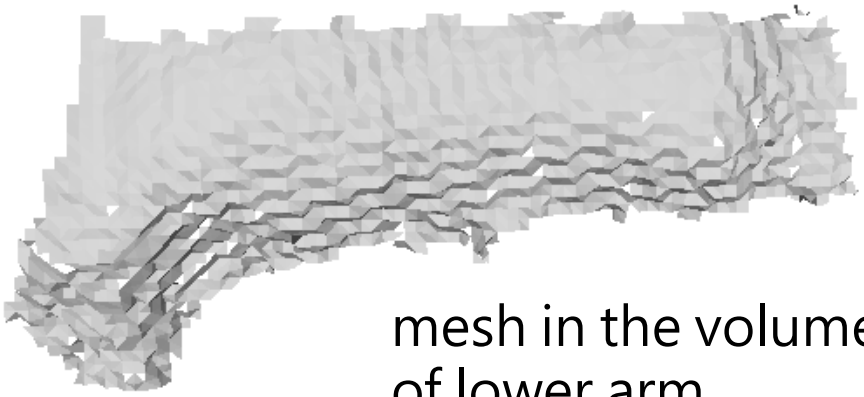


Blending result



mesh in the volume of lower arm

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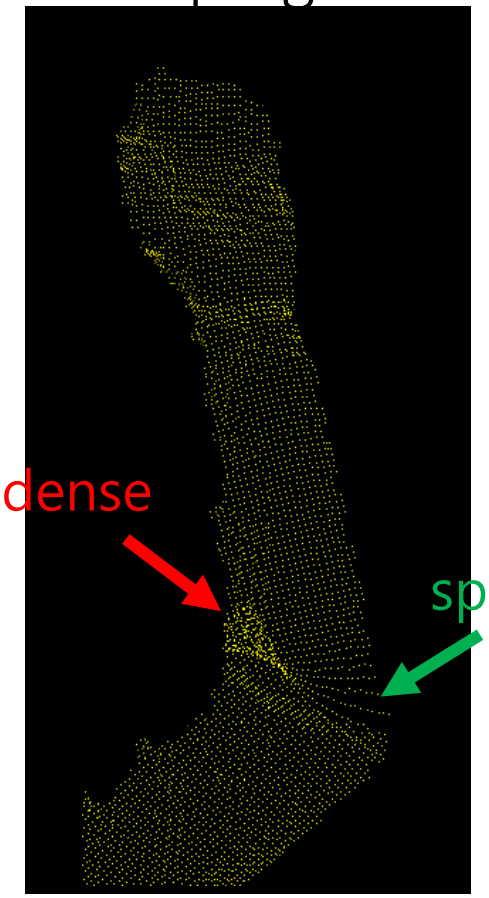
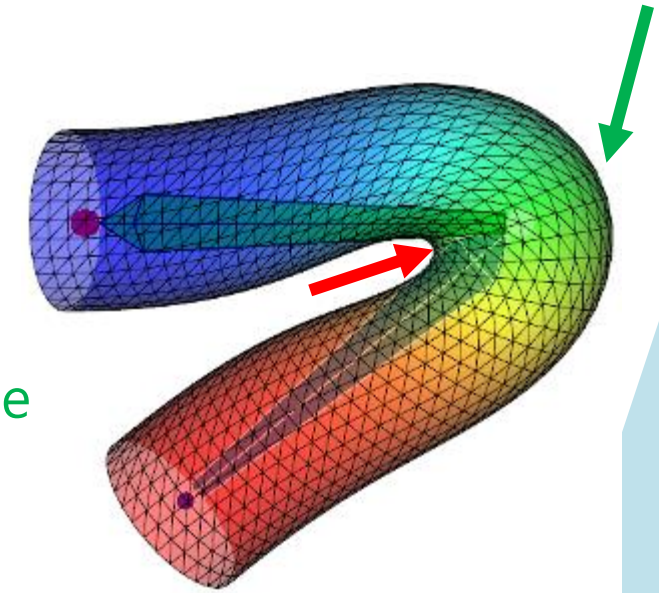
Standard meshes

- The positions of warping vertices are not correct.

First frame mesh



First frame vertices



ideal

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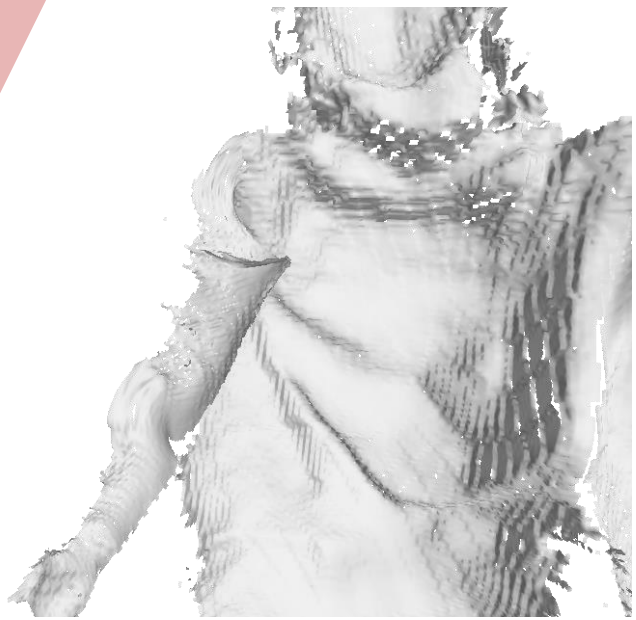
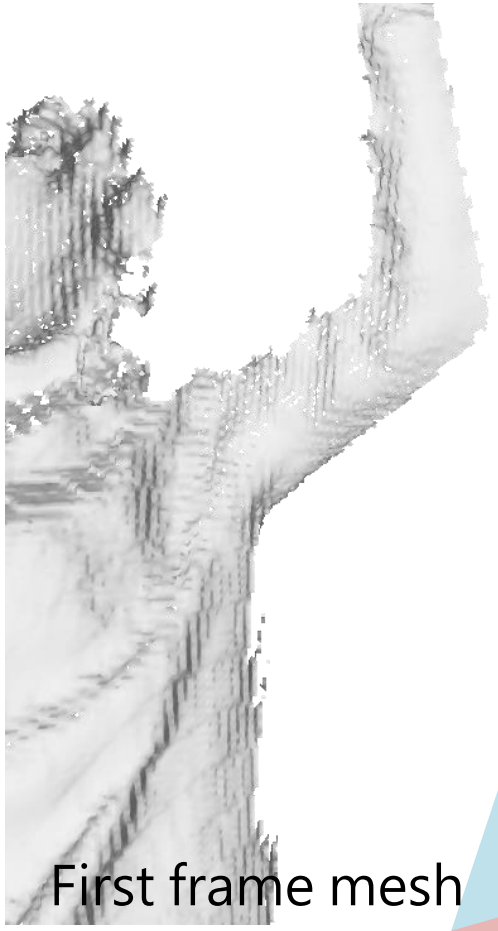
Other warping problems

- There is another problems: the deformation of clothes



Warping result
in the reserve side

Warping result



First frame mesh

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Fusion result

- Use dual quaternion warping in the TSDF fusion

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Refinement of bone's

- For each body part, fix parent joint's location and refine the other joint's position

$$error = \sum_{T} (Dis(v_T) > threshold)$$

$$Dis(v) = \begin{cases} v.z - DepthImg[\pi(Kv)], & \text{otherwise} \\ \infty, \text{ if } \pi(Kv) \text{ is outside the image} \end{cases}$$

$\pi(v)$: project 3D point v to 2D coordinate

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Refinement result

Original warping

Warping with refinement

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Refinement result

Original fusion

Fusion with refinement

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The outline

- Introduction
- Related work
- System Overview
- Methods
  - Notation
  - Initialization
  - Warping
  - Refinement
  - Integration
- Results
- Conclusions

Next step

- Complete warping method
- Refine the rotation of bones

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