Dense Correspondence between Human Bodies via Learning Transformation Synchronization on Graphs

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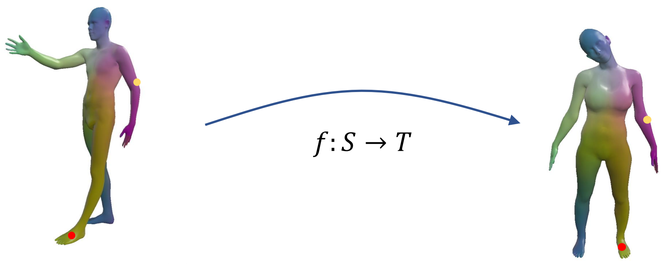
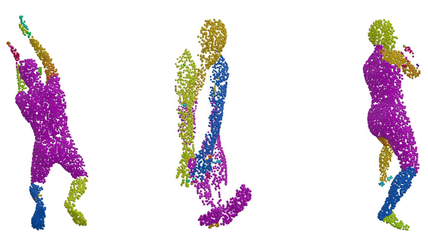
Dense Correspondence

Dense Correspondence aims at computing point-wise mapping function f, that maps any point on the source shape S to a point on the target shape T (points marked as red dots). We focus on point cloud inputs, each generated by a depth camera from a single view-point. This also generalizes to mesh inputs.



Motivation – Local Rigidity

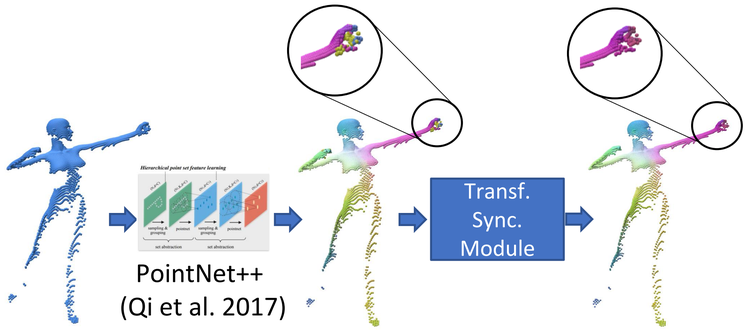
Our key assumption is that **human Bodies behaves, to good approximation, as an articulated rigid body.** This motivates us to rectifies incorrect correspondences via enforcing local rigidity. Specifically, we implement this enforcement procedure as a differentiable neural network module.



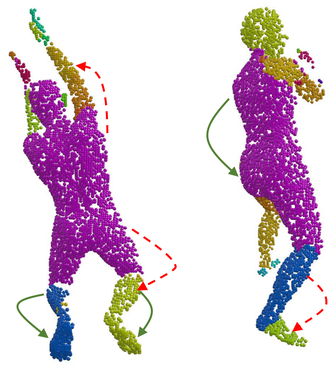
(Approximately) Rigid Body Parts

Dense Correspondence Framework

Our network consists of two modules. The first module extracts point-wise feature vectors using the standard PointNet++ backbone. The second module (Transformation Synchronization Module) learns to enforce local rigidity of human body by synchronizing point-wise rigid transformation.



Transformation Sync. Module



Good

Bad

Message Passing

$$w_i = \text{msg\_passing}(\mathrm{d_{N_i}})$$

$$\mathrm{R_i, t_i} = \sum_{\mathrm{j} \in N_i} w_j \left(R_j, t_j\right) / \sum_{\mathrm{j} \in N_i} w_j$$

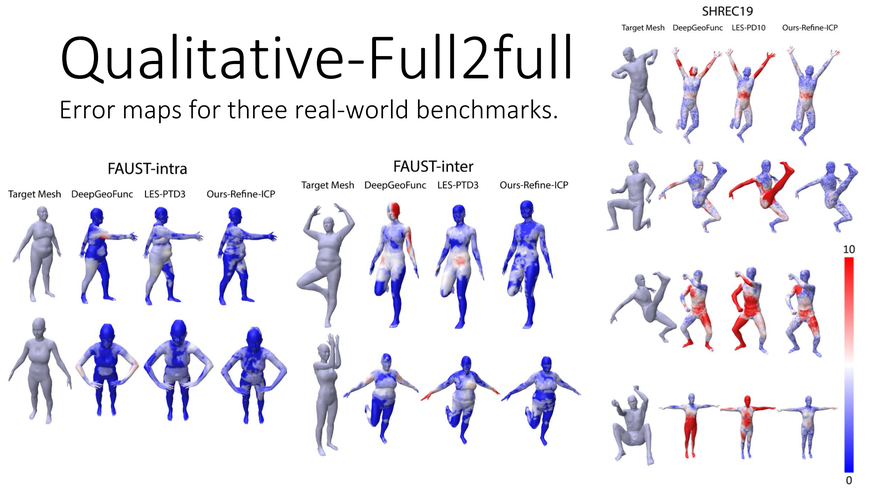
Given initial correspondences, we compute point-wise local rigid transformations to a template shape. Enforcing local rigidity is casted as propagating rigid transformation within rigid body parts, which is naturally implemented as a message passing module. The module learns the weighting parameters under an iterative reweighting scheme to guide the transformation propagation, i.e. by suppressing bad edges and encouraging good edges.

Qualitative-Partial2Full.

Left to Right: Error maps of Baseline I, Baseline II, Ours approach

Qualitative-Full2full

Error maps for three real-world benchmarks.



Quantitative Results

Full-to-Full	Faust Inter-subject	Faust Intra-Subject	Shrec19
Baseline I	2.08cm	1.97cm	6.69cm
Baseline II	2.05cm	2.32cm	5.02cm
Our Approach	1.72cm	1.42cm	3.50cm

Partial-to-Full	Surreal (Synthetic)	Faust	Shrec19
Baseline I	2.02cm	1.98cm	5.48cm
Baseline II	1.93cm	1.95cm	6.15cm
Our Approach	1.71cm	1.90cm	4.81cm

GitHub