Learning Skeletal Articulations with Neural Blend Shapes

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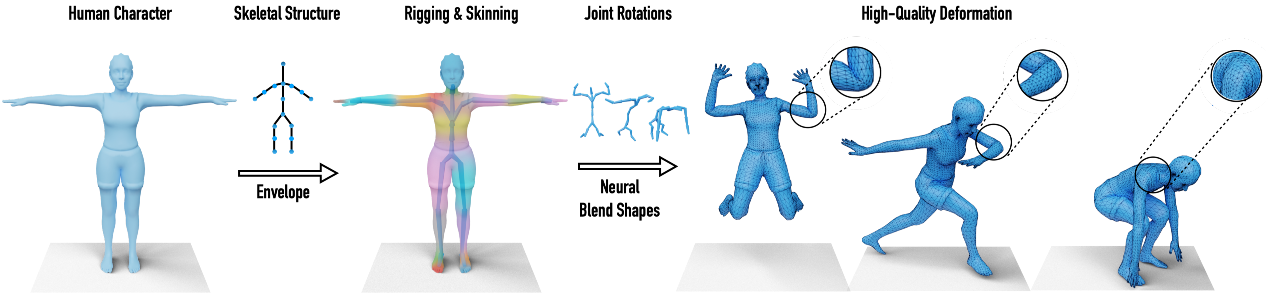
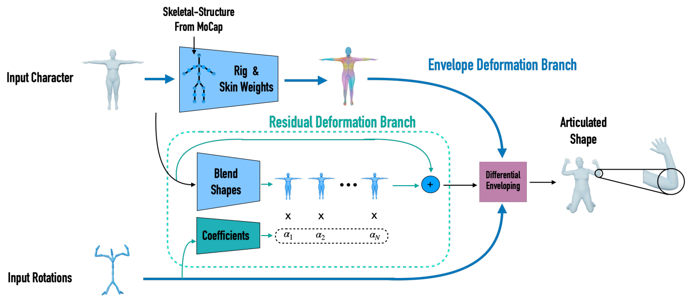


Introduction

Animating a newly designed character using motion capture (mocap) data is a long standing problem in computer animation. A key consideration is the skeletal structure that should correspond to the available mocap data, and the shape deformation in the joint regions, which often requires a tailored, pose-specific refinement. In this work, we develop a neural technique for articulating 3D characters using enveloping with a pre-defined skeletal structure which produces high quality pose dependent deformations. Our framework learns to rig and skin characters with the same articulation structure and builds the desired skeleton hierarchy into the network architecture. Furthermore, we propose neural blend shapes – a set of corrective pose-dependent shapes which improve the deformation quality in the joint regions in order to address the notorious artifacts resulting from standard rigging and skinning.

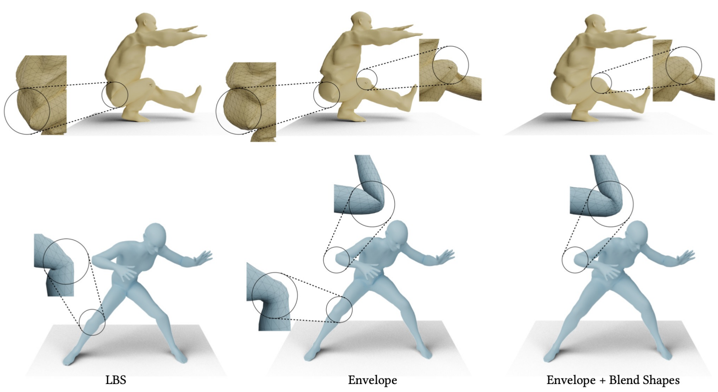
Methods

Our framework is based on MeshCNN and Skeleton-Aware architecture. It contains two main branches: (i) an envelope deformation branch that learns pose-invariant parameters (i.e., rigging and skinning), and a (ii) residual deformation branch that learns pose-dependent residual displacements. The learned skeleton rig is bound to the input geometry using estimated skinning weights. When combined with joint rotations, this defines an envelope deformation that is capable of articulating the shape.



Results

Our predicted envelope deformation produces favorable results, compared to LBS. Adding neural blend shapes to the enveloping results in corrective pose-dependent displacement, which improves the deformation quality in the joint regions.



Discussion & Conclusion

We presented an approach to train a neural network to rig and skin an input character mesh with a specific, prescribed skeleton structure and automatically generate neural blend shapes to enhance the articulated deformation quality in a pose-dependent manner. The fact that our framework incorporates the desired skeleton structure makes it practical for animation with existing motion data, such as available mocap libraries or legacy animation data of previously designed characters; the overall process is compatible with typical workflows in animation software. At the same time, the learned blend shapes ensure high quality of the output deformation, avoiding the usual LBS pitfalls, and are in general a powerful means to learn various deformation effects and apply them to unseen meshes with arbitrary connectivity. Unlike many existing example-based approaches, our system only requires a single mesh as input to compute the skeleton rig and the neural blend shapes, which makes it applicable to a large range of scenarios.

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