論文の内容の要旨

Automatic Deformation Refinement for Animated Characters via Graph Neural Networks (グラフニューラルネットワークを用いたキャラクタ変形の自動精細化)

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In animation production, animators always spend significant time and efforts to develop high-quality deformation systems for characters with complex appearances and details. However, achieving realistic deformations in real-time has always been a challenging task. Traditional geometry-based skinning methods are popular in interactive applications for their high performance but fail to generate convincing deformations, which have obvious artefacts. By formulating the deformation process within a simulation framework, physics-based methods can solve the unrealistic problem but they often trade performance for realism. As an alternative to traditional geometry-based and physics-based methods, learning-based methods train a data-driven model to compute deformation as a function of relative parameters, yet they cannot completely solve the generalization problem and cannot generate pose-related deformations, *i.e.*, the generalization to any mesh topology in any posture, and be accompanied by pose-dependent nonlinear effects.

In this work, we propose graph-learning-based, powerfully generalized methods for automatically generating nonlinear deformation for characters with an arbitrary number of vertices. Two cases are declared for different applications, *i.e.*, the 1^{st} case where the body and cloth are taken as a whole object, and the 2^{nd} case where the body and cloth are taken as separate objects. For both two cases, we adopt the idea of regarding mesh deformations as a combination of coarse and refined parts.

For the 1^{st} case, based on the coarse linear-based deformation, we propose novel graph feature representation methods and design feature propagation strategies to automati-

cally generate the nonlinear deformation. Our designed frameworks, densely connected graph-attention-network (DenseGATs) and the multi-resolution graph network (MultiResGNet), can effectively learn the huge amount of features from existing characters and easily apply them to new objects.

For the 2^{nd} case, in order to use fewer models to produce detailed clothing deformation in different poses, we design the fit parameter to express the suitableness between body and garment which is an important factor affecting wrinkles. Then, we propose an output decomposition solution to narrow the output range, thus making the learning much easier and avoiding overly smooth results. We call the framework as garment-fit-network (GarFitNet).

Experimental results show that our proposed DenseGATs, MultiResGNet, and GarFitNet can achieve better performance than prior studies in deformation approximation for unseen characters and poses.