Abstract

We present a spherical style deformation algorithm on single component models that can deform the models with spherical style, while preserving local details of the original models. Because 3D models have complex skeleton structures that consist of many components, the deformation around connections between each single component are complicated, especially preventing mesh self-intersections. To the best of our knowledge, we could not find not only methods to achieve a spherical style in a 3D model consisting of multiple components but also methods of a single component. In this thesis, we focus on spherical style deformation of single component models, and propose a method which deforms the input model with the spherical style, while preserving the local details of the input model. We explore a cluster of linear features of the sphere shape and describe these features as ℓ_2-regularization. According to the feature descriptions, energy function is established which combines the ARAP term and the spherical term. An efficient optimization solution is also provided to solve the energy function. We have performed our method on convex and smooth models, convex and sharp models, finally complex models with different linear spherical features respectively. In our experiments, energy can be well converged. Based on these experimental results, we analyze the effect of each feature on spherical style deformation for single component models and achieve a most suitable feature for deformation. Our approach can deform the input model smooth, rounder and curved successfully, while preserving local details of the original input model. At the same time, we showed deformation results of different sphere center positions. We also compared our experimental results with the 3D geometric stylization method of normal-driven spherical shape analogies and confirmed that our method successfully deforms models smooth, rounder, and curved. Limitations, problems and future work of our method based on the experimental results are also discussed.

We also found that the results of our deformation are dependent on the quality of the input mesh. When the input mesh consists of many obtuse triangles, it leads to potential oscillation of the numerical method, poorly conditioned matrices, worsening the speed and accuracy of the linear solver and above spherical style deformation method fails. To solve this problem, we propose an optional deformation method based on convex hull proxy model as the complementary deformation method. Our proxy method constructs the proxy model of the input model and applies above spherical style deformation method to the proxy model. Finally, deformation result of the input model is obtained by the projection calculation between the proxy model and the input model and interpolation method between the input model and the deformed proxy model. We performed this proxy method to the obtuse triangle mesh and confirmed that the method can achieve better results, such as smoother surface, compared with above spherical style deformation method. At the same time, various t functions and partial deformation options give more kinds of deformation possibilities. Finally, we discuss the limitations of the proxy method.