Computer Graphics

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Paper Review: The Shape Space of 3D Botanical Tree Models

In modern society, the three-dimensional models of plants are generally used in many areas. Due to the various forms, types and topological structures of trees in nature. If people want to build a three-dimensional model with realistic visual effect, the modeling process is very complicated and time-consuming. This article is introducing a mechanism for creating new data from an existing one, which got the algorithm easier. However, there are still two main challenges for this technical. One is computing accuracy, another is continuous blending of structures. And this article gave a solution by representing 3D tree models with graphs that encode geometry and structure together, which is a mechanism for computing one to many correspondences between models. Interactive techniques and generative models are main methods in this article. There are several steps in this framework algorithm. Source and target botanical trees are given at first. They would be converted 120 polygonal tree models into skeleton representation. A recursive iteration representation of a simple botanical tree was used in this step. Dashed lines without attributes are applied as annotation. Second, they used nodes V, edges E and geometric attributes A to encode jointly the geometry and structure of botanical tree for finding branch correspondence. Third, they got augmented graph through simplify. Converting a three orders tree into a binary tree by introducing virtual nodes V and edges E of dashed line. The same tree here could have a variety of possible parameterization, which did not change the

process of computing. The final step is to generate smooth joint blending of geometry and structure. It demonstrated several examples of geodesics and showed it can be used for reflection symmetry analysis and symmetrization of three dimensional botanic trees. This model is automatic except for defining the upright direction of the trees.

They compared their methods with other state-of-the-art works, the other approaches all had problems on finding correct correspondences between the source and target botanical tree models, defining a proper tree-shape space and a metric, performing tree statistic and tree symmetrization, getting stochastic trees between the source and target trees without smooth nature or computing one-to-more correspondences from the space of the procedural model parameters to the space of botanical trees. However, they perfectly figured out all of these problems. They got smooth and natural geodesics and they got significant breakthrough on processing time, which saved up to five hundred and forty minutes per geodesic.

There are still some disadvantages in this framework. First, the trunk of every tree has been identified and fuzzy correspondences are expected to be applied instead of correspondences under assumption. Next, tree leaves are not considered in framework. The foliage structure should be changed smoothly along the blending paths. Then, the process of computing geodesics has no enough quality. What is more, the computation time can still be decreased even though it has been better than other state-of-the-art works. It takes a little bit long time when running MATLAB.

In conclusion, this was an extremely informative paper that clearly described the shape space of 3D botanical tree models.

Paper Review: Appearance Modeling via Proxy-to-Image Alignment

In a modern society, people are living in a digital world. 3D model can be found anywhere around our life, such as in the field of designing and high-end computer games. A photorealistic texture and detail 3D models are required in these fields. Also, computer graphic artists always using the pictures of the real thing in the world to generate their digital creations. Therefore, the technology for converting the real thing to a digital model on the internet is desirable now. However, it is a complex work to setup a fully detailed 3D model starting from scratch, especially for the target which is in irregular appearance.

For current state-of-the-art, the automatic method of extracting a fully detailed realistic 3D object from a single digital image still not practical and based on many kinds of assumptions.

In this case, this article, Appearance Modeling via Proxy-to-Image Alignment, provides a method to improvement current solution. The process is divided into two parts. First, build a rough 3D shape. Secondary, enriching the coarse model with medium and fine-scale geometric deformations and displacements. As extracting a nonparametric appearance model from a photograph and applying such a model to a target 3D shape. The paper assumes that the image we chosen for reference object has a rough geometric proxy. Since the source proxy is just a rough approximation of the

reference object, if we want to recover the geometric detail and the diffuse reflectance texture of the source object, we must first align non-rigidly deform the source proxy with the reference object. By this way, we can decorate a detail-less target shape by the extracted appearance model from other picture, yielding a richly detailed 3D model, whose fine-scale appearance greatly resembles by the reference object. It is a new two-step method for geometry-correlated transfer of appearance extracted from the reference object in a single 2D image to a new 3D target shape, which allow users to easily decorate 3D shape models with medium- and fine-scale geometric deformations and displacements, as well as realistic surface texture.

After reading this paper I found it addressed a challenging stage of the modeling pipeline via proxy-based appearance extraction from a single image and geometry-correlated transfer of the extracted appearance onto new shapes. The improvement of this modeling approach is advanced in separate the progress of modeling a complex fully detailed 3D model to two steps. First is to build a rough 3D model as a proxy of the target object. Then, using a creative method to transfer the rough model to a fully decorated 3D model by deforming and aligning with the reference object and recovering the surface details by the extraction method of Barron and Malik.

However, there are still some limitation for the current method. The extraction method is based on Barron and Malik's approach, and it is based on some assumptions. In the experiment, some attribute is assumed in a certain environment.

So, I hope to extend this modeling method in more general situation. In the future, I believe this method will play an important role in the 3D modeling field.

Conclusion of paper review:

These two paper all discussing the method of modeling. One is an advanced algorithm of building a 3D Botanical Tree, another is an improvement of building a realistic, fully detailed 3D model. Both of two papers is related on present a realistic model in the virtual world. In this way, we can find the tendency of 3D modeling is required more realistic in the future. Especially in the field of designing and virtual reality technology.