Variational Texture Atlas Construction and Applications

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Abstract:

The use of attribute maps for 3D surfaces is an important issue in Geometric Modeling, Visualization and Simulation. Attribute maps describe various properties of a surface that are necessaray in applications. In the case of visual properties, such as color, they are also called texture maps.

Usually, the attribute representation exploits a parametrization $g : U \subset R^2 \rightarrow R^3$ of the surface in order to establish a two-dimensional domain where attributes are defined. However, it is not possible, in general, to find a global parametrization without introducing distortions into the mapping. For this reason, an *atlas* structure is often employed. The atlas is a set of charts defined by a piecewise parametrization of the surface, which allows local mappings with small distortion.

Texture atlas generation can be naturally posed as an optimization problem where the goal is to minimize both the number of charts and the distortion of each mapping. Additionally, specific applications can impose other restrictions, such as the type of mapping. An example is 3D photography, where the texture comes from images of the object captured by a camera [2]. Consequently, the underlying parametrization is a projective mapping.

In this work, we investigate the problem of building and manipulating texture atlases for 3D photograpy applications. We adopt a variational approach to construct an atlas structure with the desired properties. For this purpose, we have extended the method of [1] to handle the texture mapping set-up by minimizing distortion error when creating local charts. We also introduce a new metric tailored to projective maps that is suited to 3D photography.

Projective texture atlas serve as a the foundation for an attribute processing framework. We exploit it in the user interface of a texture editing / painting interactive application. Other features incorporated into this framework include: texture compression, blending and inpainting. Our current research is looking into using surface attributes like normal and displacement fields for modeling operations.

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