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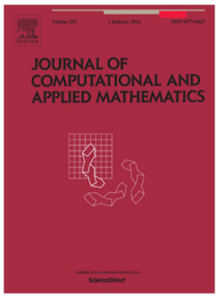


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# A Novel Local/Global Approach to Spherical Parameterization☆

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**Abstract**

This paper proposes a novel local/global spherical parameterization for the genus-zero triangular mesh, which naturally extends the planar approach to the spherical case. In our method, we derive two fitting matrices (conformal and isometric) in 3D space. By optimizing the so-called spring energy, the spherical results are achieved by solving a nonlinear system with spherical constraints. Intuitively, it represents the stitching together of the 1-ring patches to form a unit sphere. Moreover, the derivation of the 3D fitting matrices can also be applied to planar triangles directly, so that we can obtain a class of novel planar approaches (conformal, isometric, authalic) to the problem of flattening triangular meshes. In order to enhance robustness of the proposed spherical method, a stretch operator is introduced for dealing with high-curvature models. Numerical results demonstrate that our method is simple, efficient and convergent, and it outperforms several state-of-the-art methods in terms of trading-off the distortions of angle, area and stretch. Furthermore, it achieves better visualization in texture mapping.

*Keywords:* Geometric modeling, Spherical parameterization, Stretch operator

## 1. Introduction

Recently, spherical parameterization has become a fundamental research topic in computer graphics, and can be widely used in texture mapping, surface remeshing and mesh morphing. It is equivalent to embedding the connectivity graph of the original mesh on the sphere, and assigning a 3D position to each of the mesh vertices. In this process, a good spherical result should have no overlapping of the resulting triangles, and preserve the geometric properties of the original mesh as much as possible.

In this paper, we focus on the spherical parameterization, and propose a novel local/global spherical parameterization. Our work is mainly inspired by the planar methods [1, 2, 3, 4] and the spherical methods [5, 6]. Our methods are based on the optimization of the spring energy [7], and stitching together the 1-ring patches to form a unit sphere. It is a natural extension of the planar local/global approach to the spherical case. In order to enhance robustness of our spherical method, an r-adaptive stretch operator [8] is introduced for dealing with high-curvature models. Consequently, our method has a good trade-off the distortions of angle, area and stretch, so that it achieves a better visualization in texture mapping than those by other methods, see Fig. 1.

The main contributions of this paper are as follows,

- We devise two novel fitting matrices (isometric and conformal) between two triangles in 3D space, so that the planar local/global approach [2] can be extended to the spherical case naturally. Moreover, our ARAP further simplifies the original ARAP [6] by stitching together 3D triangle instead of individual tetrahedron, and the distortions of our ARAP is better than original ARAP (Section 4.1 – 4.3).

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