Non-Linear Technique for Spherical Coverings and Application to Forms

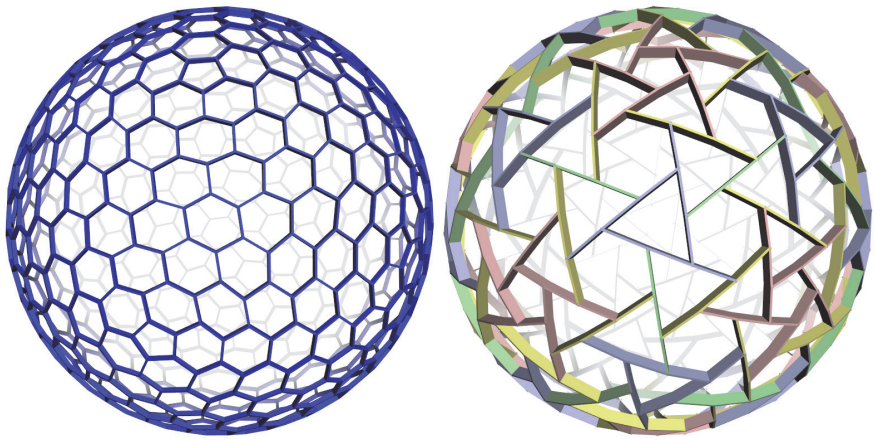
Christopher J. Kitrick

ckitrick@gmail.com

Abstract

Many spherical tessellations are optimization problems. This paper describes a general technique for solving complex spherical tessellations that require a non-linear approach and shows its application to two different spherical shell geometry problems: a) general equal edge hexagonal topology and b) spherical nexorades, a form of reciprocal frames. Both tessellation problems are specific optimization problems that require a non-linear technique. The technique extends beyond what this author [1] presented previously as a partial solution to the equal edge topology problem.

For any spherical tessellation the distances of vertices from their immediate neighbors is varied and numerous division methods that have been developed generally only limit the number of different edge lengths that arise. With hexagonal tessellations it has been shown that a single edge length does exist but the methodology derived only works for a subset of the possible topology. In addition, these tessellations have an infinite solutions of edge lengths but the desire is to find the optimal solution: the smallest edge possible for a particular topology. This paper describes a non-linear form finding solution that works for the entire range of hexagonal tessellations, achieving what appears to be an optimal edge length. The basic technique is to iteratively adjust vertex locations while propagating the edge changes.



References

[1] Kitrick C., Equal Edge Hexagonal Spherical Tessellations, *International Journal of Space Structures*, IASS Symposium 2015

[2] Clinton J., A Group of Spherical Tessellations Having Edges of Equal Length, *5th International Conference on Space Structures*, G. A. R. Parke and P. Disney (ed.), Thomas Telford Limited, 2002

[3] Coxeter, H.S.M., Virus Macromolecules and Geodesic Domes, *A Spectrum of Mathematics*, 1971, B. C. Butcher (ed.), Auckland University Press, pp 98-107

[4] Baverel, O, Nooshin H., Kuroiwa Y. and Parke G.A.R, Nexorades, International Journal of Space Structures, Vol.15 No. 2 2000

[5] Baverel, O., Nooshin, H., "Nexorades Based on Regular Polyhedra," *Nexus Network Journal*, vol. 9, pp. 281-298, 2007