Mean value coordinates for non-convex polyhedra and applications to terrain modeling

Francesco Patrizi
SINTEF
francesco.patrizi@sintef.no

Mean value coordinates were introduced in [1] as a way of expressing a point in the kernel of a star-shaped polygon as a convex combination of the vertices. It was shown there that these coordinates can be successfully used to compute good parameterizations for surfaces represented as triangular meshes, based on convex combination maps.

Such coordinates are particularly useful for interpolating data that are given at the vertices of the polygon. For this reason, they can be efficiently used in computer graphics and geometric modeling.

Many other generalizations of barycentric coordinates to convex polygons have been introduced in the last decades. However, while such constructions break down when used in the nonconvex setting, mean value coordinates were successfully extended for arbitrary planar polygons without self-intersections [2].

Furthermore, Mean value coordinates were also addressed for the 3D case, for convex polyhedra or in the kernel of a star-shaped polyhedra [3].

In this work, we study how the 3D coordinates extend to arbitrary points in $\mathbb{R}^3$, even for arbitrary polyhedra with a view to the application in 3D modeling of geophysical structures for simulation purposes.

Joint work with: Michael S. Floater, Georg A. Muntingh.

References

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[2] Hormann, K., Floater, M.S., *Mean value coordinates for arbitrary planar polygons*, 2006, Advances in Computational Mathematics 24.

[3] Floater, M.S., Kos, G., Reimers, M., *Mean value coordinates in 3D*, 2005, Computer Aided Geometric Design 22.