Iterative coordinates

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Barycentric coordinates provide a simple way of expressing the linear interpolant to data given at the vertices of a triangle and have numerous applications in computer graphics and other fields. The generalization of barycentric coordinates to polygons with more than three vertices is not unique and many constructions have been proposed [3]. Among them, mean value coordinates in [2] stand out by having a simple closed form and being well-defined for arbitrary polygons, but they may take on large negative values in the case of concave polygons, leading to artefacts in applications like shape deformation (see Fig. 1).

We present a modification of mean value coordinates [1] that is based on the observation that the mean value coordinates of some point v inside a polygon can be negative if the central projection of the polygon onto the unit circle around v folds over. By iteratively smoothing the projected polygon and carrying over this smoothing procedure to the barycentric coordinates of v, these fold-overs as well as the negative coordinate values and shape deformation artefacts gradually disappear, and they are guaranteed to completely vanish after a finite number of iterations.

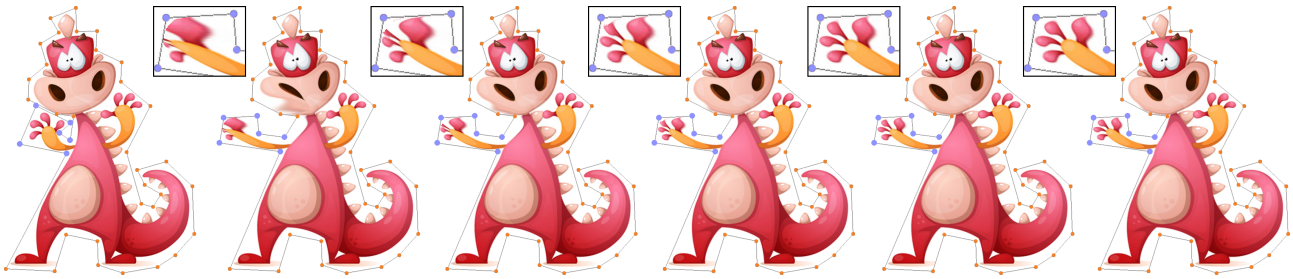

Figure 1: Deformation of a source image (left), obtained by moving six vertices (blue) of the control polygon. The deformation based on mean value coordinates ($k = 0$) exhibits severe artefacts, caused by negative coordinate values. Using iterative coordinates, these deformation artefacts gradually disappear as the number of iterations increases ($k = 1, 2, 3, 4$).

Joint work with: Chongyang Deng, Kai Hormann.

References

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[2] M. S. Floater. Mean value coordinates. *Computer Aided Geometric Design*, 20(1):19–27, 2003.

[3] K. Hormann and N. Sukumar, editors. *Generalized Barycentric Coordinates in Computer Graphics and Computational Mechanics*. Taylor & Francis, CRC Press, Boca Raton, 2017.