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Report on the doctoral thesis entitled

Algorithms for Minkowski Pythagorean hodograph curves

by Jiri Kosinka.

The interesting class of Pythagorean hodograph (PH) curves, which is characterized by the property that the length of the first derivative vector (or "hodograph") is a (possibly piecewise) polynomial of the curve parameter, was introduced by Farouki and Sakkalis in 1990. Later, this notion was generalized to Minkowski space, where the length of a vector is defined by an indefinite metric. PH curves in Minkowski space (MPH curves) are very well suited for representing the medial axis transform of a planar domain. Indeed, as observed by Choi et al (1997), they correspond to planar domains where both the boundary curves and their offsets are rational curves.

In his thesis, J. Kosinka discusses geometrical and algorithmical aspects of cubic MPH curves.

The second chapter collects several preliminary results. These include information about the differential geometry of curves in Minkowski space and the relation between Minkowski curvature and the curvature of the corresponding boundaries of the associated planar domain.

The third chapter presents a geometric classification of MPH cubics. It is shown that these curves are helices (curves of constant slope) in Minkowski space. (Similar results exist for PH cubics in Euclidean space). By carefully discussing the various possible cases, the author derives equivalence classes and normal forms of MPH cubics under the group of similarities in Minkowski space. The results of this chapter have been accepted for publication in Sitzungsberichte d. Österr. Akad. Wiss.

Chapter 4 is devoted to algorithmical aspects of MPH cubics, by discussing interpolation of G^1 Hermite boundary data (2 points with associated tangents). The author studies the solvability and the asymptotic behaviour (the approximation order) of the interpolating curves. These results will be published shortly in Computer Aided Geometric Design.

The thesis is very well written and the results are illustrated by many beautiful pictures. As shown by the results, which will be published shortly in internationally recognized journals, the author is able to do research and to obtain interesting and original results. Summing up, the work presented in this thesis is excellent and I feel that it fulfills the requirements of a Ph.D. dissertation.

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