Abstract

The presented work concerns approximation of the low cardinality sets of points and their associated normal vectors by quadratic surfaces, and its utilization in selected topics of geometry processing. The computation of the coefficients of the quadric is based on minimization of an objective function which accumulates weighted algebraic distances and normal deviations. Apart from detailed description of the function, we explore its properties and behaviour with respect to various types of weights. Polygon mesh is one of the most frequently used representations of objects in 3D computer graphics and geometric modelling. The task of the construction of the mesh with large number of vertices from the coarse input is known as mesh subdivision. We propose the quadric fitting based method QFS for subdivision of tri/quad meshes. Based on the results, QFS produces meshes comparable to established, mainly linear subdivision schemes. Moreover, we discuss the suitability of QFS for approximation of coarsely sampled algebraic surfaces. We employ the quadric fitting also for the task of computation of the curvature at the vertices of the mesh in the proposed method QFC. We provide several comparisons between QFC and other commonly used methods. These indicate, that QFC is robust to the irregular sampling of the input mesh. We introduce also novel method PU-QF for upsampling of unorganized point-normal sets. Compared with current state-of-the-art methods, PU-QF yields better results in terms of preservation of geometric details and noise robustness.

Keywords: *mesh, point cloud, quadric fitting, subdivision, upsampling, curvature*