

A Fast and Adaptive Surface Reconstruction Algorithm Based on Implicit Tensor-Product B-Spline Surfaces ^{*}

Weihua Tong Falai Chen
Department of Mathematics
University of Science and Technology of China
Hefei, Anhui 230026, People's Republic of China

Abstract

Based on the implicit tensor-product B-spline (ITPBS) representation of surfaces, we propose a fast and adaptive algorithm to solve the surface reconstruction problem—reconstructing a surface from a dense set of point clouds. Our algorithm is driven by a surface fitting model proposed in [19], which amounts to solving a quadratic optimization problem. We explore the matrix form of the surface fitting model, and put forward a fast and low memory consumption algorithm to compute the matrices based on the features of ITPBS functions. With some elaborate analysis and the help of some appropriate data structures, the matrix computation requires only $\mathcal{O}(U)$ operations and $\mathcal{O}(M)$ storage space, where U is the number points in the point clouds and M is the number of unknown coefficients of the ITPBS surface. In addition, we present heuristic ideas on how to adaptively choose the knot vectors of the ITPBS surface. For non-uniform(adaptive) sampling point sets, two algorithms are provided for generating the adaptive knot sequences. We conclude the paper with some illustrating examples and conclusion remarks.

Keywords: surface reconstruction, implicit B-spline surface, point cloud, spare matrix

^{*}Supported by Outstanding Youth Grant of NSF of China (no.60225002), the TRAPOYT in Higher Education Institute of MOE of China and the Doctoral Program of MOE, China (no.20010358003).