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散乱点云谷脊特征提取

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Valley-ridge feature extraction from point clouds

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摘要 利用微分"化曲为直"的本质特性和离散计算方法,提出了一种基于局部重建的散乱点云谷脊特征提取算法.首先,利用离散Laplacian算子对点进行增强,通过阈值过滤标记潜在谷脊点.然后,在每个潜在谷脊点的局部邻域内构建紧附于潜在曲面、能反映该点局部几何特征信息的三角网格.最后,根据Weingarten映射的性质,估算潜在谷脊点的主曲率和主方向;将邻域大小作为尺度参数,利用简单直观的离散计算方法及线性插值方法,多尺度地判定一点是否为主方向上的曲率极值点,从而提取谷脊特征.实验结果表明:当点云规模为10 375个,谷脊点规模为1 129个时,执行时间仅为97.39 ms;当点云规模达327 853个,谷脊点规模达到105 482个时,执行时间为3 956.12 ms.该方法简单、稳定,避免了传统的利用拟合曲面再逼近微分量方法中由于曲面拟合带来的高时间代价,能快速有效地提取散乱点的云谷脊特征.

关键词 : 点云模型, 特征提取, 谷脊特征, 离散计算

Abstract : On the basis of characteristic of differential "curl to straight" and disperse calculation method, an extraction method using local reconstruction and differential calculation was proposed for valley-ridge features from point clouds. First, the dispersed Laplacian operator was used to enhance the point data and an appropriate threshold was set to obtain potential valley-ridge points. Then, a triangle mesh attached on the potential surface was constructed in every valley-ridge points to effectively reflect the local geometry feature information. Finally, according to Weingarten mapping, principal curvatures and principal directions of potential valley-ridge points were calculated. A simple differential calculation method and a linear interpolation method were used to decide if the point is an extreme value point in principle direction and to extract the valley-ridge features based on the multi-scaling idea. The experimental results indicate that when the number of vertexes and the number of valley-ridge features are 10 375 and 1 129,respectively, the execute time is just 97.39 ms. And when those are 327 853 and 105 482, the execute time is 3 956.12 ms. The method proposed in this paper is simply, stable, and avoids higher time cost due to fitting surface to approximate the differential quantities in the traditional method, so it extracts valley-ridge features from point clouds fast and efficiently.

Key words : point cloud feature extraction valley-ridge feature differential calculation

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