Compare LRSC with LRSCPK

August 18, 2013

With a noisy point cloud $\mathcal{P} = \{p_i\}_{i=1}^N$ as input, we estimate the normal by low-rank subspace clustring (LRSC) and low-rank subspace clustering with prior knowledge (LRSCPK), respectively. First, we detect the points which are near sharp features. Then, for each of these points, the neighborhood of it is segmented by LRSC and LRSCPK respectively. Finally, using the segmentation results we select a consistent subneighborhood to estimate the normal.

For a candidate feature point p_i, we first select a larger neighborhood $\mathcal{N}_i^*$ of size S^* than $\mathcal{N}_i$ used for candidate feature points selection. In the local coordinates with p_i as the origin, the neighbor point p_{ij} of p_i is represented as $p_{ij} = [x_j, y_j, z_j]$, where $[x_j, y_j, z_j]$ is the coordinate of $p_{ij} \in \mathcal{N}_i^*$. The sampling matrix is defined as $X = [p_{i1}, p_{i2}, \cdots, p_{iS^*}]$.

The optimal coefficient matrix $Z \in R^{S^* \times S^*}$ of LRSC can be computed by solving

$$min\|Z\|_* + \gamma\|E\|_{2,1} \quad s.t. \quad X = XZ + E, \tag{1}$$

and the optimal coefficient matrix $Z \in R^{S^* \times S^*}$ of LRSCPK is computed by solving

$$min\|Z\|_* + \beta\|\mathcal{P}_\Omega(Z)\|_1 + \gamma\|E\|_{2,1} \quad s.t. \quad X = XZ + E. \tag{2}$$

After obtaining the affinity matrix by $S = |Z| + |Z|^T$, we segment $\mathcal{N}_i^*$ by NCut.

The normal estimation results are shown in Fig 1. From the results we can see that LRSCPK can get more accurate segmentation results and estimation normals. However, when the neighborhood of a point contain multiple feature lines, as the marked narrow-band regions, the segmentation results of LRSCPK remain contain some errors. To improve the effectiveness and stability of LRSCPK for segmentation, we add the normals information to sampling matrix, as Fig 2 shows. From the results we can see taht with the normals information LRSC and LRSCPK can get more accurate segmentation. Moreover LRSCPK can get better results when the neighborhood of a point contain multiple feature lines.

1 Reference

[1]Jie Zhang, Junjie Cao, Xiuping Liu, Jun Wang, Jian Liu, Xiquan Shi. Point Cloud Normal Estimation via Low-Rank Subspace Clustering. Computers &

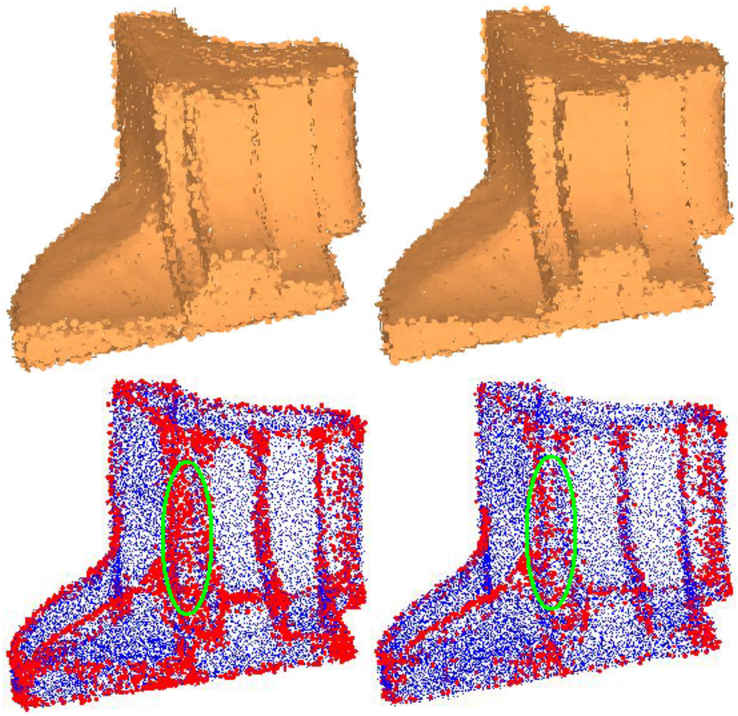

Figure 1: Normal estimation results of LRSC and LRSCPK on Fandisk model which is perturbed by centered Gaussian noise with the standard deviation of 50% average distance between points. The top row is the results rendering using surfels and the bottom row is the visualization of bad points. Left to right are the results of LRSC and LRSCPK, respectively.

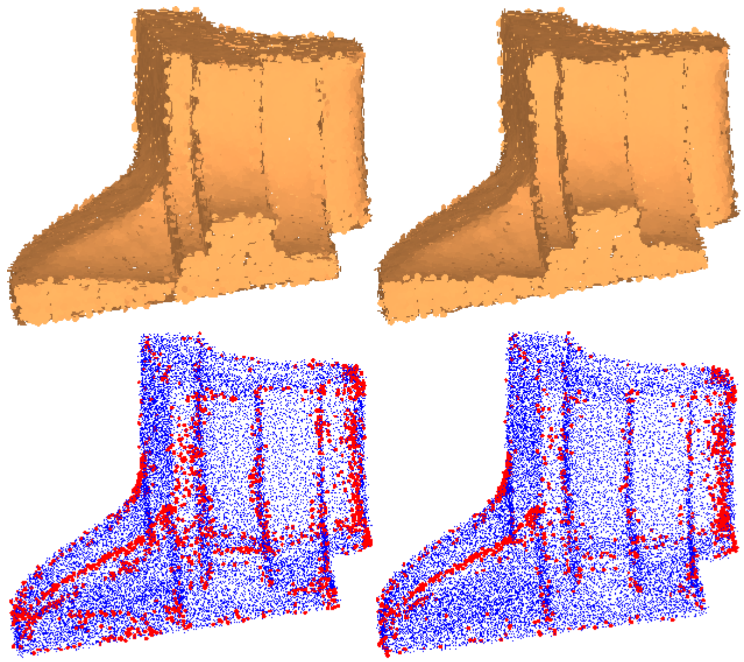

Figure 2: Normal estimation results of LRSC and LRSCPK on Fandisk model which is perturbed by centered Gaussian noise with the standard deviation of 50% average distance between points. The top row is the results rendering using surfels and the bottom row is the visualization of bad points. Left to right are the results of LRSC and LRSCPK, respectively.

Graphics, 37(6):697-706(2013)