3D Interest Point Detection via Discriminative Learning

September 17, 2014

Problem

What the paper sets out to solve

- Identification of important points in 3D meshes
- Previous work (Lowe) Scale Invariant Feature Transform (SIFT)
- Task specific variances are hard to express geometrically
- One main difficulty in discrepancy between quantifiable and perceived importance of points

Premise

- Previous work assumes correspondence between perceptually and quantitatively important points.
- Varying degrees of success (varying requirements and subjectivity are problems)
- Paper formulates 3D interest point detection as a binary classification problem
- $Geometricdetectors \rightarrow Attributes \rightarrow Learningalgorithm$

Evaluation method

- Benchmarked with method by Dutagaci et al. Where ground truth interest points are selected by non-expert users by clicking.
- Makes subjectivity and semantics a significant factor $\rightarrow$ hard for pure geometric methods

Related work

- Six other methods performance evaluated on same benchmark
- *Mesh Saliency*: Local curvature estimates. $Totalsaliency = \sigma DoG$
- *Scale Dependent Corners*: Geometric scale variability of 3D mesh on 2D representation
- *Salient Points*: DoG filters to vertex coordinates $\rightarrow Scalemap \rightarrow Localmaxima(interestpoints)$

Related work

- *Heat Kernel Signature*: Laplace-Beltrami operator over mesh. Heat diffusion process highlights local maxima.
- *3D Harris*: Harris and Stephens Corner detector to 3D. Rings of vertex play role of neighbouring pixels
- *3D SIFT*: *Mesh* $\rightarrow$ *Voxelrep.* $\rightarrow$ *SIFT*

Method

- Random forest classifier takes attributes
- Downsampling of majority class in order to avoid misclassifying minority cases
- Correct classification defined as geodesic distance between point and truth point $< \epsilon$
- Performance very good across test cases
- Increased ability to handle subjectivity compared to other methods tested