3D Computer Vision: Techniques & Applications

Project 2: 3D Shape Search Engine

Project Deadline: 11:55 PM, Oct. 14, 2015

No late submission will be accepted

In this project, you are going to design a shape search engine on dataset **TOSCA**[1] (smallTOSCA.zip) to retrieve relevant 3D shapes for given query in Matlab. The dataset contains a total 147 objects, including 9 cats, 6 centaurs, 11 dogs, 21 gorillas, 17 horses, 15 lionesses, 3 wolves, 6 seahorses, 24 female figures and two different male figures, containing 15 and 20 poses. Detailed project instructions are given as following:

1. Write Euclidean and Geodesic Distance based shape descriptors (refer to lecture slides)

2. Simulate noise on the surface of 3D shape: you could add Gaussian noise on the given clear 3D shapes by using the given source code. Please generate 3 noise shapes with different noise level for each given clean 3D shape in the dataset. You could simply change the value of *noiseLevel* to get shapes with small/medium/large noise when running the addGaussianNoise.m (There's no specific standard for small/medium/large noise. You could make your own choice).

    Example to get noise shape with different noise level:

    inputFile = 'C:\...\b0.off';
    outputFile1 = 'C:\...\b0_noise1.off';
    outputFile2 = 'C:\...\b0_noise2.off';
    outputFile3 = 'C:\...\b0_noise3.off';

    addGaussianNoise(inputFile,outputFile, 0.002);
    addGaussianNoise(inputFile,outputFile, 0.008);
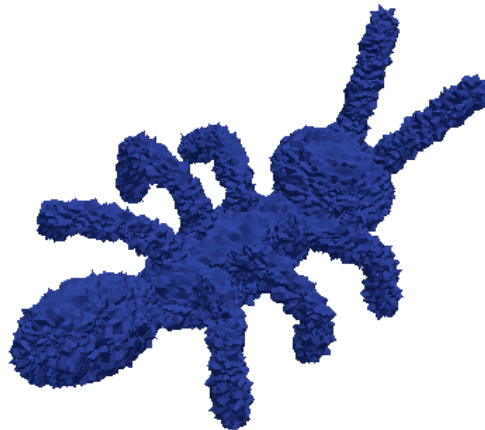   *addGaussianNoise(inputFile,outputFile, 0.015);*

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[1] Reference: http://tosca.cs.technion.ac.il/book/resources_data.html

Example for adding Gaussian Noise on 3D shape:
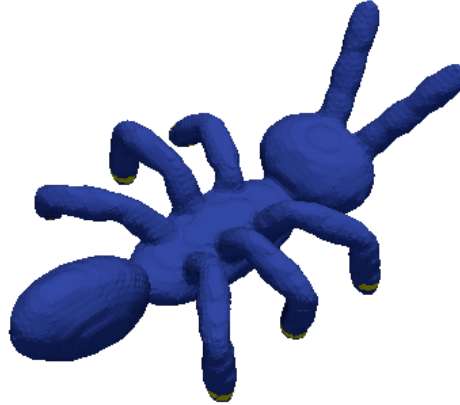
3D shape before adding noise

3D shape after adding Gaussian noise

3. Simulate incomplete 3D shapes using Meshlab program (refer to *MeshLab for incomplete model.ppt*): Please generate 3 incomplete 3D shapes with different levels of incompleteness (small, medium, large) for each given clean 3D shape in the dataset.

4. Design a shape search engine GUI and demo: Please design a GUI, which takes a query 3D model and then displays the top five retrieved models.

Simple example for GUI:

Reference:
http://www.mathworks.com/videos/creating-a-gui-with-guide-68979.html

5. Experimental evaluation of the shape search engine based on Precision-Recall curve and MAP: You need to test your shape search engine on (1) clean 3D shape dataset, (2) clean 3D shape dataset + noise 3D shape dataset and (3) clean 3D shape dataset + incomplete 3D shape dataset. Please provide Precision-Recall curve and MAP in your report for the three tests. (Note: you should take every model in the dataset as a query to run a shape-retrieval test against the entire dataset. You will get a PR curve for each search test, and the average curve of all individual PR curves will be used as final PR curve to evaluate the performance of a search engine.)

6. 50 bonus points will be given to those who can propose a new shape descriptor and compare the performance to ED and GD descriptor with an experimental analysis. (Note: your descriptor does not have to perform better than ED or GD. Please describe your idea clearly in your report and valuate the performance of your descriptor on given 3D shapes, noise 3D shapes and incomplete 3D shapes as mentioned above)

Note: You may discuss the general concepts in this project with other students, but you must finish your program on your own. NO SHARING OF CODE OR REPORT IS ALLOWED. Violation of this policy can result in grade penalty.

What to submit

Please submit a .zip file containing a working shape search engine with GUI and a report for the detailed description of the project (how the project was coded, how you simulate noise 3D shapes, how you conducted your experiments, how your descriptor performed and how to run your search engine). Before submit your project, please make sure to test your program on all the given dataset.