

CENG 789—Digital Geometry Processing

ASSIGNMENT I

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2 Weeks

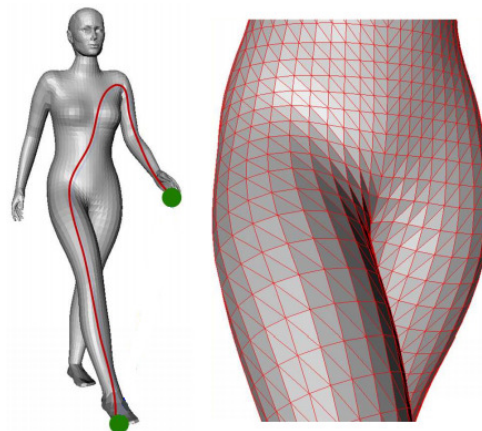
Distances, Sampling and Descriptors on Meshes (start early!)

3D Graphics Programming Setup {0 points}

You can use any 3D SDK in this and all other assignments. For OpenGL, OpenMesh, OSG, libigl, and VTK setup, see http://youtu.be/D9B_cxUB_LU, <http://www.openmesh.org>, <https://youtu.be/115PAVCj2iY>, <http://libigl.github.io/libigl>, and <https://youtu.be/IgvbhyDh8r0>, respectively. I prefer an SDK called Coin3D Open Inventor which is built on top of OpenGL. It comes with a nice viewer that provides a trackball navigation system as well as different rendering modes¹ so that you do not have to implement these features using OpenGL's primitive GLUT or something. Here is how you can set it up on Windows:

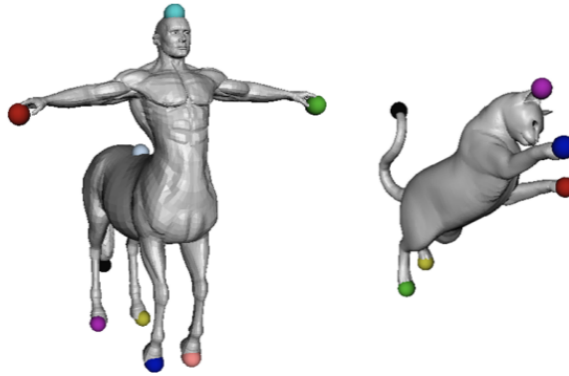
- 1) Download Coin3D, an independent implementation of API: ceng.metu.edu.tr/~ys/Coin3D.zip
- 2) Unzip it to, say, C:\Coin3D
- 3) Visual Studio → New Project → Visual C++ → Win32 Console Application → Application Settings → Empty Project
- 4) Place your code file, e.g., ~ys/HelloWorld.cpp, under Source Files
- 5) Right click on your Project Name and then hit Properties → C/C++ → General → Additional Include Directories: write C:\Coin3D\include;
- 6) C/C++ → Preprocessor: add COIN_DLL;SOWIN_DLL;
- 7) Linker → General → Additional Library Directories: write C:\Coin3D\lib;
- 8) Linker → Input → Additional Dependencies: add coin2d.lib;sowin1d.lib;
- 9) Paste Coin3D\coin2d.dll and sowin1d.dll files into your-work-folder\Debug folder (google other missing files reported when you try to execute the program, if any, and put them in this folder too, e.g., MSVCR71D.dll)

Geodesics on Meshes - Dijkstra{25 points} Geodesic distance between two mesh vertices is the length of the shortest path along the surface that connects the two, as shown below. Since surface is discretized as an undirected graph, all you have to do is implement the Dijkstra's Shortest Path algorithm discussed in the class. Print the $N \times N$ geodesic distance matrix M to file for the N -vertex input mesh. Visualize the path between two query points, e.g., by redrawing the edges on the path with thicker red lines as below. Report timings with three structures for Q : array, min heap, and Fibonacci heap (disable fprints).

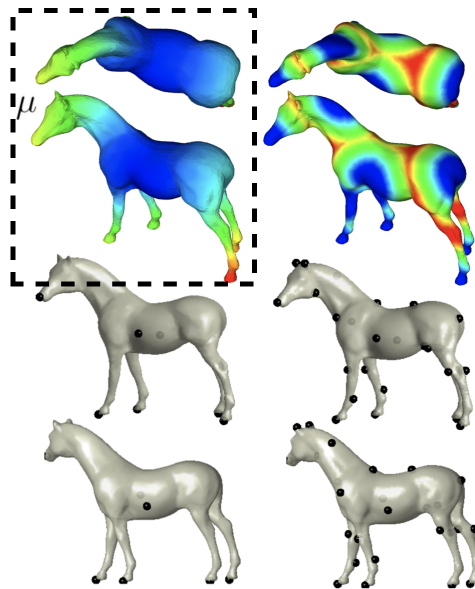


¹See my short demo at <http://youtu.be/lK7aoc1AO8w>

Sampling on Meshes{15 points} Implement the Farthest Point Sampling algorithm discussed in the class. Compute 10 samples, starting from the vertex maximizing the Average Geodesic Distance function μ , and display them as spheres.



Symmetry-Invariant Sampling{60 points} Implement a sampling algorithm that selects a set of critical points, e.g., local maxima, of a symmetry-invariant function. You may use μ (dashed box). See the details in Section 4 of the paper titled Mobius Transformations For Global Intrinsic Symmetry Analysis.



Submission This assignment constitutes 20% of your final grade. Use the meshes provided in `~ys/meshes1.zip`. Good luck. Send to `ys@ceng.metu.edu.tr` your code, executable, and resulting files as well as screenshots. In a text file, mention the encountered problems and interesting observations.