Deformation Transfer

Naveen Kumar 140050013 | Rajat Chaturvedi 140050027 | C Vishwesh 140050031 | Suman Swaroop 140050032

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1 Introduction

Deformation transfer applies the deformation exhibited by a source triangle mesh onto a different target triangle mesh.Approach is general and does not require the source and target to share the same number of vertices or triangles, or to have identical connectivity.The user builds a correspondence map between the triangles of the source and those of the target by specifying a small set of vertex markers.Deformation transfer computes the set of transformations induced by the deformation of the source mesh, maps the transformations through the correspondence from the source to the target, and solves an optimization problem to consistently apply the transformations to the target shape.

2 Implementation

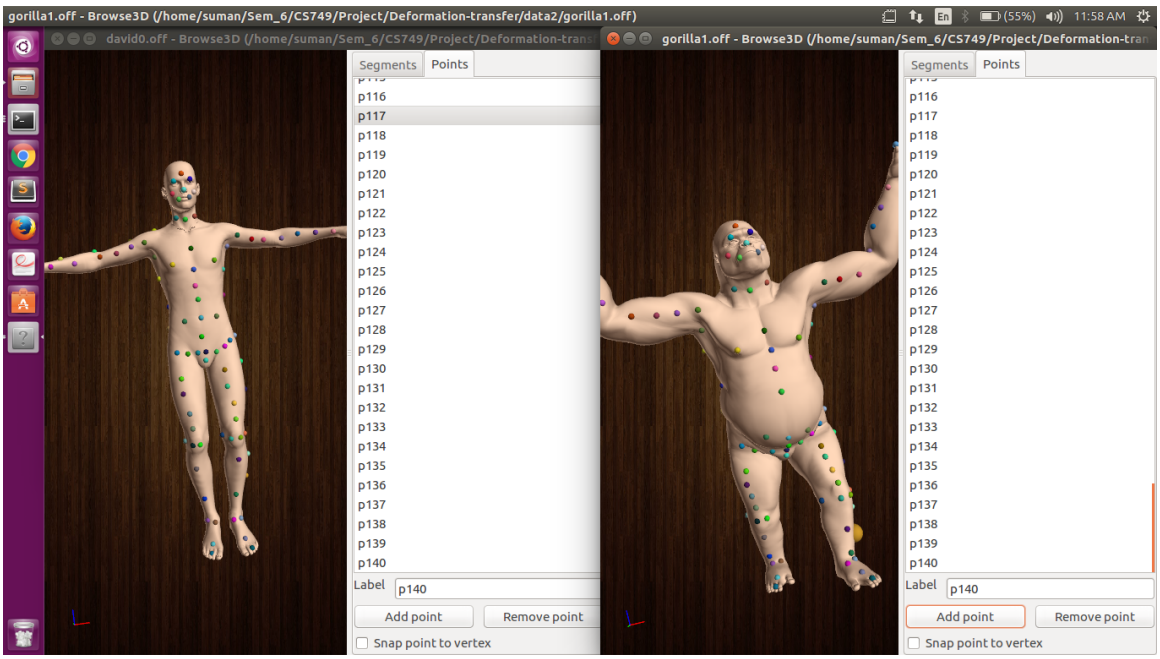

Figure 1: Marking Corresponding points using Browse3D tool in Thea

To accomplish the deformation, the project is divided into multiple layers of implementations which are independent of each other.

- We first manually selected 70-80 markers points marking corresponding points from both the meshes using the Browse3D tool.
- Then we used Deform tool to sample 1 point (centroid) from each face of the target mesh.
- We sampled the source mesh uniformly using the MeshSample tool.
- Then we used the Register tool using the sampled and picked points to get corresponding point for each sampled point of the target mesh.

- Then we made a correspondence map mapping each face of the target mesh with a face of the source mesh using the corresponding points generated previously. This is done by taking the face whose centroid is at the least distance from the point as the corresponding face of that point.
- Then we calculated the A and c as follows : We equated S_{s_j} with T_{t_j} and got 9 equations for each j. Doing this for the whole correspondence map forms the A and c matrix of $Ax = c$ where A is a sparse matrix and x is the vector of unknown vertex positions(linearized into x) of the target's deformed mesh.
- After that we solved $Ax = c$ as a least squares problem using python and got the target's deformed vertex positions
- After that we converted it into a .off file using these deformed vertex positions and the same faces as in the target mesh

3 Results

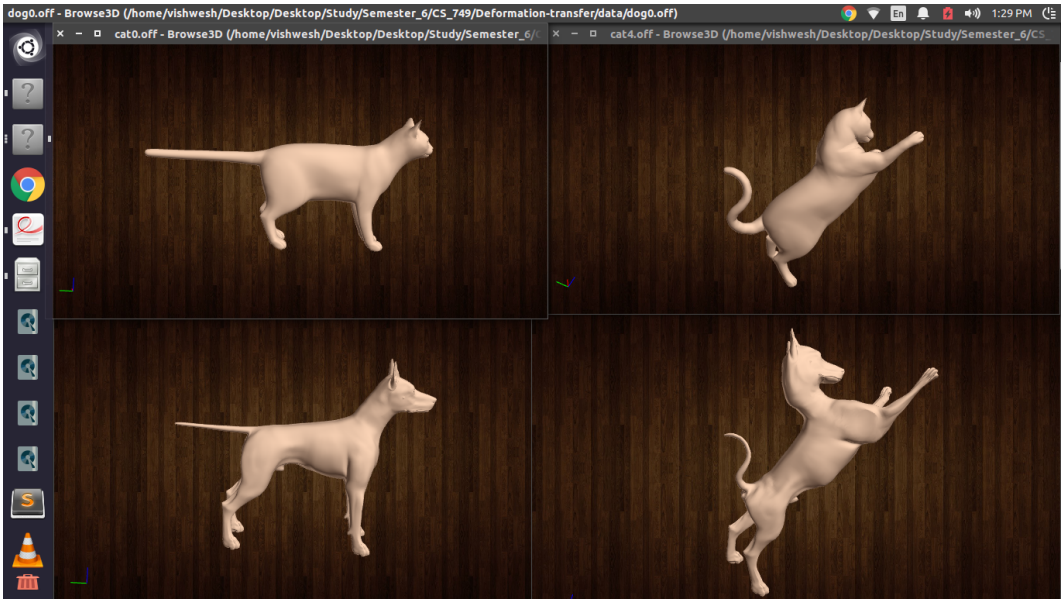

Figure 2: Cat Dog Deformation Transfer

In fig.2 Observe that the neck part of dog is somewhat distorted.This is mostly because of the correspondence.Cat's Neck is small and hence didn't corresponded well to that of dog's using the tool.

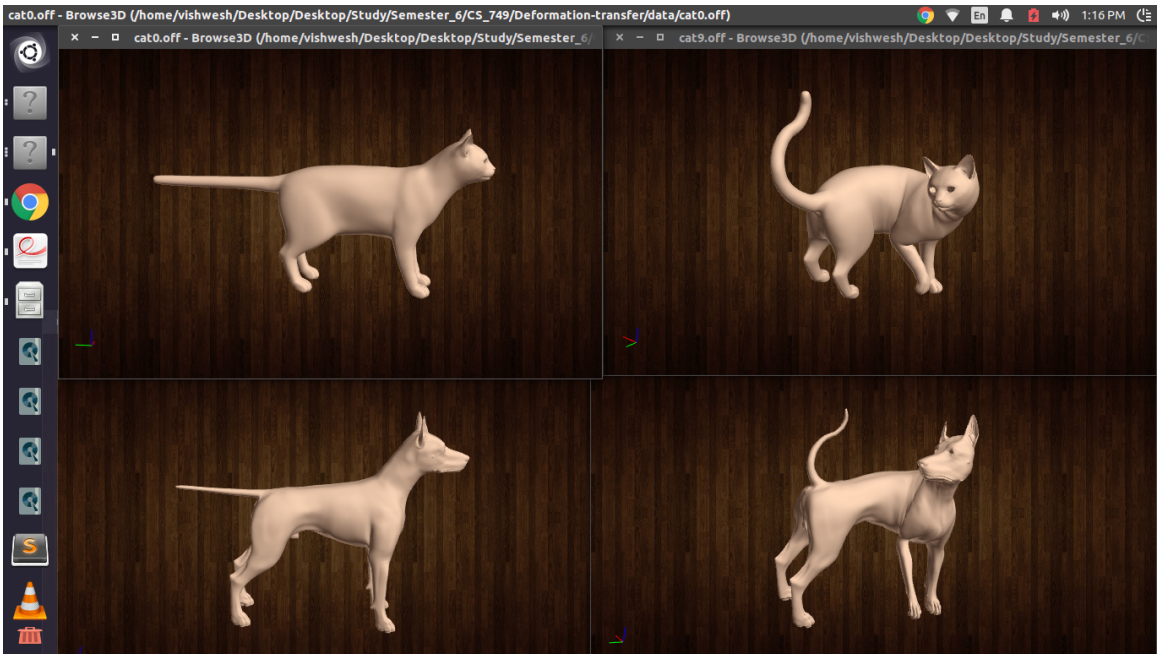

Figure 3: Cat Dog Deformation Transfer

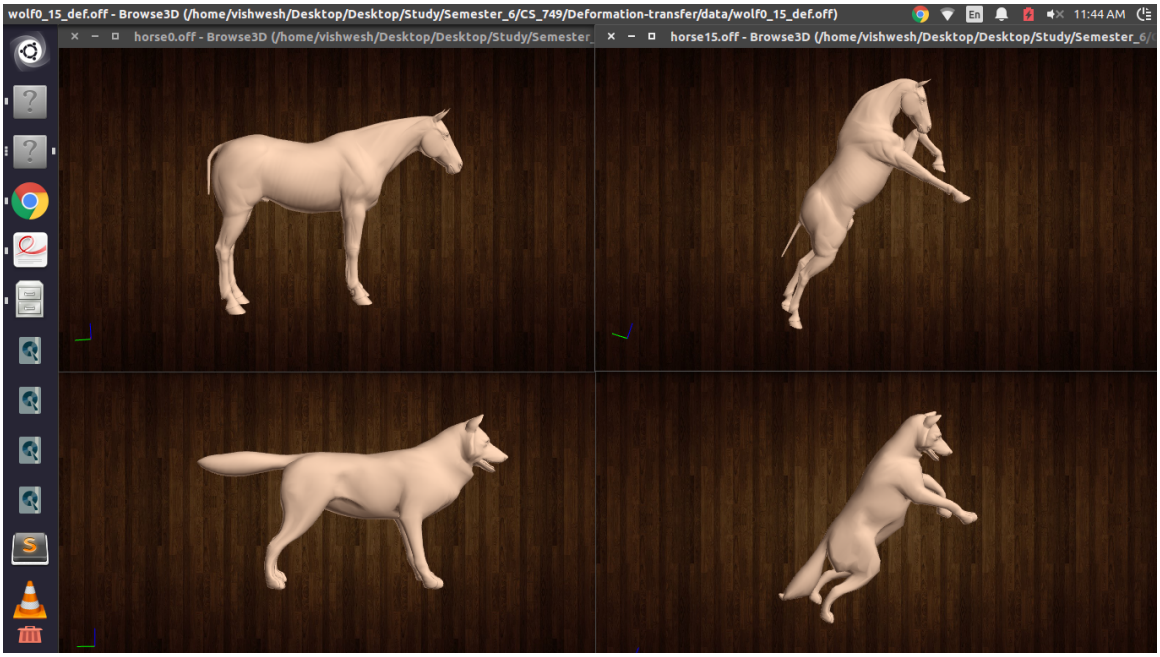

Figure 4: Horse Wolf Deformation transfer

In fig. 4 front leg of wolf is bending from a point where there is no movable joint.This shows that the transformation is realistic and practical for semantically equivalent skeletons only.They can be made almost equal by having the correspondence mapped more accurately in this case.

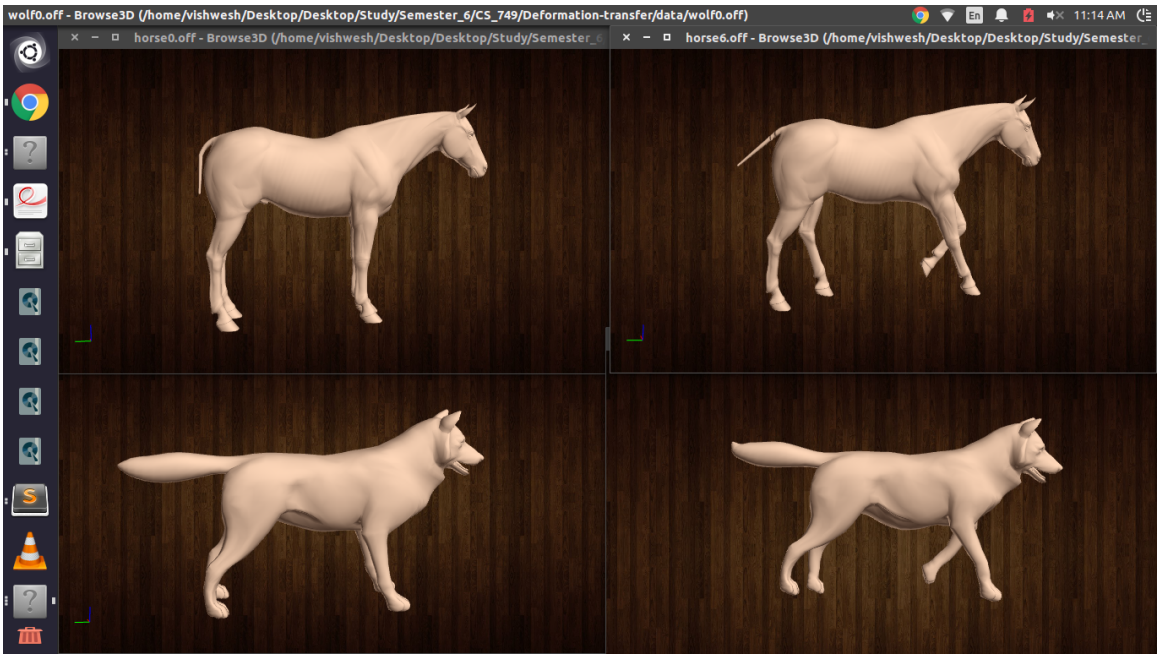

Figure 5: Horse Wolf Deformation Transfer

4 Work Distribution

Project involved following tasks

- A) Data Collection, manipulation and other stuffs:
  1. Data was provided in tri/vert format, converted into off format. .off files
  2. Marking 'n' corresponding points between two meshes.(.picked files)
  3. Sampling points from mesh for source mesh
  4. Report work
- B)Scripts:
  1. arrange.py : Conversion of result x(after applying affine transformation) to the .off format.
  2. sparse_script.py : Solver for Ax=c where A is a sparse matrix
  3. Deform: Generation of Corresponding faces using the corresponding points generated from Thea tools
  4. Deform: Construction of matrix A and vector c
  5. Deform: Sample 1 point (centroid) from each face of target mesh
  6. markers.sh : Convert the .picked files into correct format
  7. Base Code Organization : Re-writing the base code for mesh representation in the format we required using code from assignments
  8. run.sh : Run all the sub-tasks and provide the output
- Naveen Kumar : 140050013 - B1, B2, B7, A2
- Rajat Chaturedi : 140050027 - B5, B7, A1, A3
- C Vishwesh : 140050031 - B4, B6, A4, B7, A1
- Suman Swaroop : 140050032 - B3, B8, B7, A2, A4

5 Reference

- Paper : dl.acm.org/citation.cfm?doid=1015706.1015736
- Dataset : http://tosca.cs.technion.ac.il/book/resources_data.html