Extraction of Skinning Data by Mesh Contraction with Collada 1.5 Support

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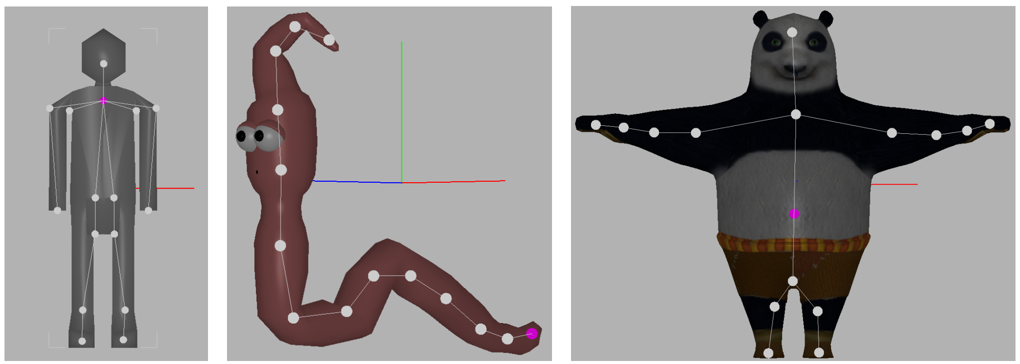
The most common approach to animate models and determine their shape attributes in computer graphics is using skeletons. The skeleton and skinning weights can be either assigned manually or computed from an input mesh. This Master's Thesis proposes the extraction of a skeleton and skinning weights from a mesh, describes how to store computed data in Collada 1.5 and use it for an animation. Firstly, the mesh is contracted using constrained Laplacian smoothing in a few iterations. Then the most important vertices from the contracted mesh are chosen as control points. Multiple edges are removed and vertices that are very close to each other are merged. We select and collapse a vertex pair with the minimum cost in every iteration using a greedy algorithm. The greedy selection is applied repeatably until we have the requested number of bones. In the next step the skinning weights are computed according to if we want rigid or soft skinning. In the postprocessing stage the user can inspect the skeleton by previewing skinning deformations, make desired changes and export the skeleton to Collada 1.5. Transformation matrices used in a hierarchical skeleton tree are not transformed to joint's local transformation frame, so they are immediately compatible with majority of animation software and libraries. After the Collada file containing the mesh, the skeleton and the skinning data is exported, data can be imported in animation software such as 3D Studio Max, Blender or Maya and a skinning animation can be rendered.



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The extracted skeletons have sparser nodes at the core parts of the model. This feature can be observed, because many faces at core parts are contracted into the same region. Computed skeletons are independent of the size and resolution of the models. The approach is insensitive to noise, but works only for closed mesh models with 2D manifold connectivity.

Main contributions of our work can be summarized here:

1. Added support for models composed of more components
2. Removed dependency on model resolution and dimensions
3. Added collapsing of close vertices before greedy selection
   - grants good results on low resolution models
4. Fluently distributed weights over the mesh regions
   - geodesic distance is a real-value function which varies smoothly along the mesh
5. Implemented export of all computed data into Collada 1.5

References

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