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Concept of Skeleton Texture Mapping

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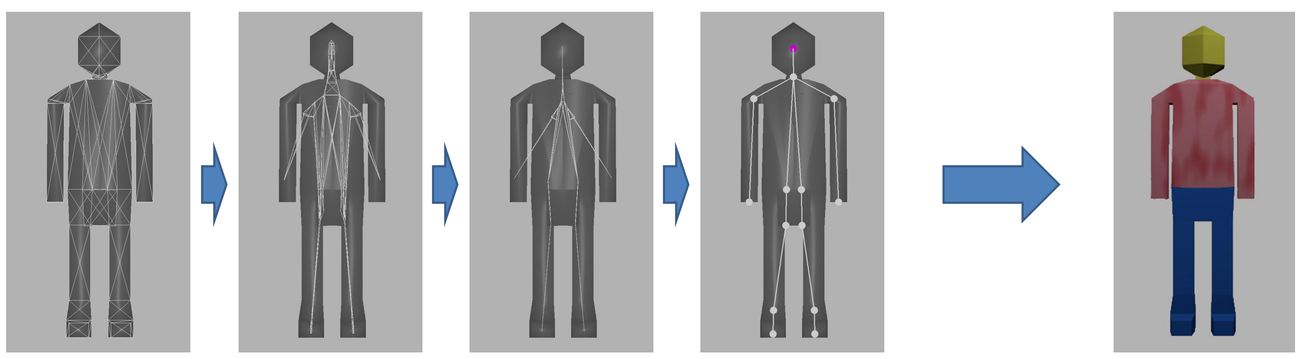
Abstract

We introduce an idea for novel way of mapping textures onto a surface of 3D model. Our technique is based on two interlocking mappings, the first one maps surface vertices onto computed skeleton and the second maps surrounding area of each skeleton segment into a rectangle with dimensions based on surface properties around this segment. Furthermore, these rectangles are packed into a squared texture by approximately solving an optimization problem which seems to be NP-complete. With our technique, we are able to map the texture onto the surface without any precomputed or stored texture coordinates. Our texture mapping approach is also suitable for surfaces with topology non-homotopic to a sphere.

Skeleton Texture Mapping

2) Retrieving of absolute texture coordinates for each skeleton segment



1) Skeleton extraction stage

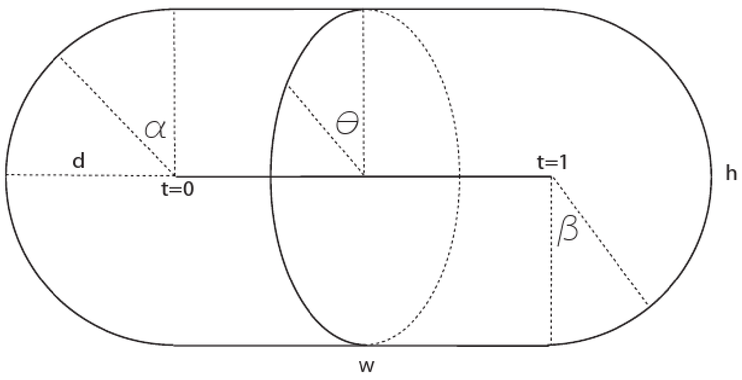
3) Textured 3D model

- [1] is used for 2D manifold mesh
- [2] is used for surface with boundaries, polygon soup or point clouds

- storing of uv coordinates is not needed
- deterministic algorithm
- works with topology non-homotopic to a sphere

i. mapping between mesh vertices and skeleton nodes is stored
ii. surrounding surface area of each skeleton segment is mapped into a rectangle
iii. relative texture coordinates to rectangle origin are assigned
iv. rectangles are packed into squared texture
v. absolute texture coordinates are computed

Segment Mapping

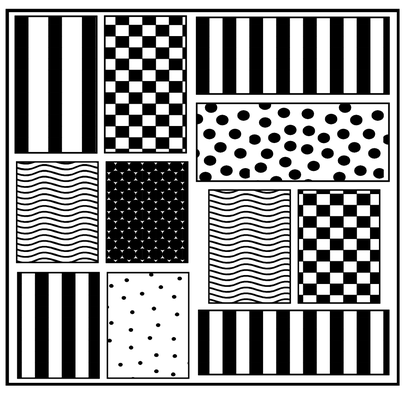


Skeleton segment parameterization between two nodes. Coordinates are computed from parameter d, dimensions of the rectangle and pairs of angles which correspond to spherical coordinates of the mapped vertex.

Packing Problem

$$u = \frac{\theta}{2\pi} h$$

$$v = \begin{cases} d(1 - \frac{\alpha}{\pi/2}) \\ d + t(w - 2d) \\ w + d(\frac{\beta}{\pi/2} - 1) \end{cases}$$



- solving an optimization packing problem
- well defined local neighborhood for each texel
- each rectangle is enclosed in mirrored parts of itself

Applications and Future Work

Skeleton Texture Map (STM) - our mapping technique can be used for extracting a STM from textured mesh with classical uv coordinates or applying STM onto a surface without parameterization.

Skeleton Displacement Map (SDM) - encodes vertex displacements from the skeleton. The skeleton and SDM are extracted from an input and they are later used for reconstruction of the model surface.

- SDM and skeleton can be used as data structure for model representation
- procedural textures enhancing models surface can be aligned by skeleton axis, skeleton can store important surface parameters and they can be applied during mapping
- STM can be used for seamless texture space diffusion (i.e. real-time approximation of subsurface scattering [4] on complex surface)

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References

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