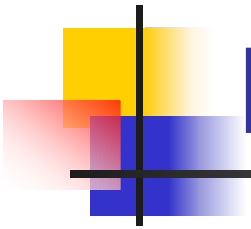
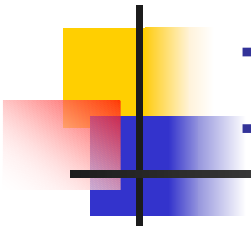
3D WATERMARKING: Data Hiding on 3-D Triangle Meshes

Mustafa Teke
Multimedia Research Group
Electrical & Electronics Engineering
Middle East Technical University



Problem Definition

- Hiding information into 3D Objects with minimum distrotion rate,
- And make the watermark robust against attacks.



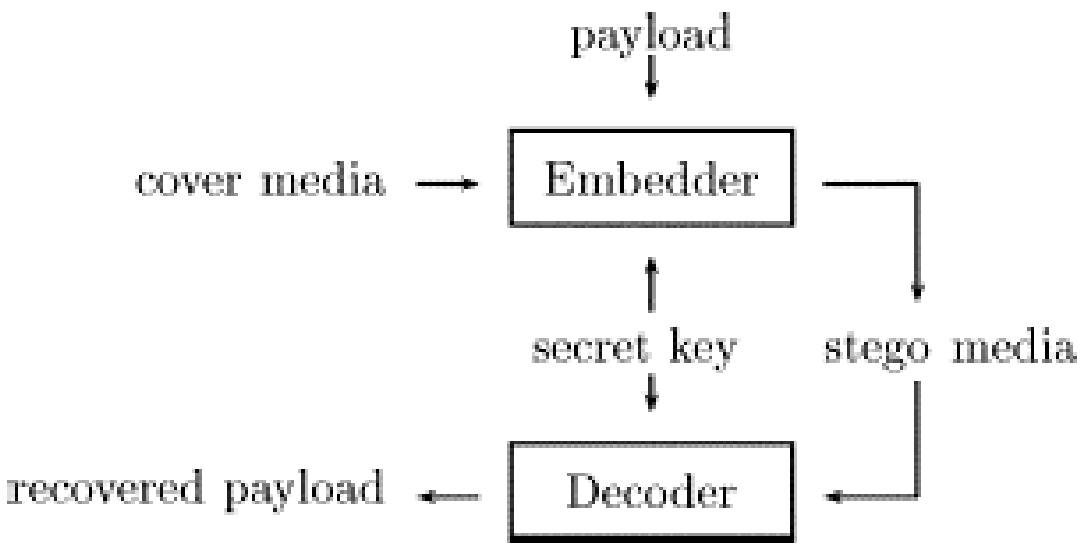
Intro

- The Method is Robust against : Translation, Rotation and Scaling.
- TSPS: Triangle Strip Peeling Sequence.

  [Cayre *et al* April 2003]
- Considers triangles as two state objects.
- 3D Objects -> 2D Traingles.
- Uses a “Secret Key”.

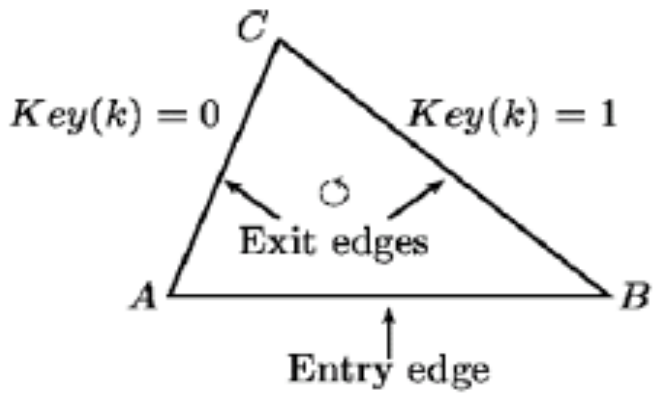
Intro

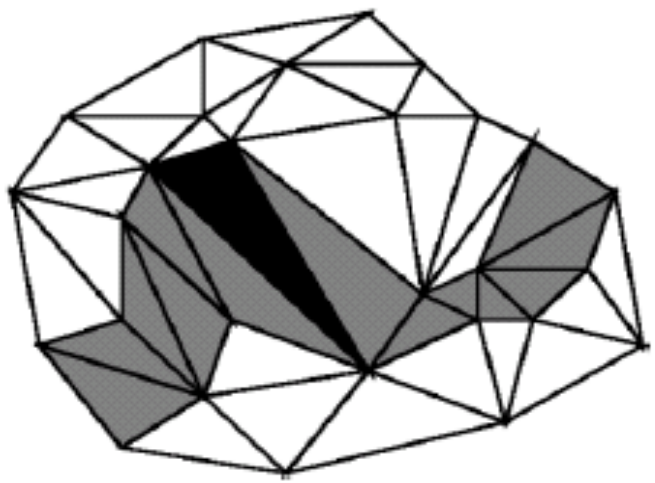
- Blind Watermarking



Method is Implemented as Blind Watermarking

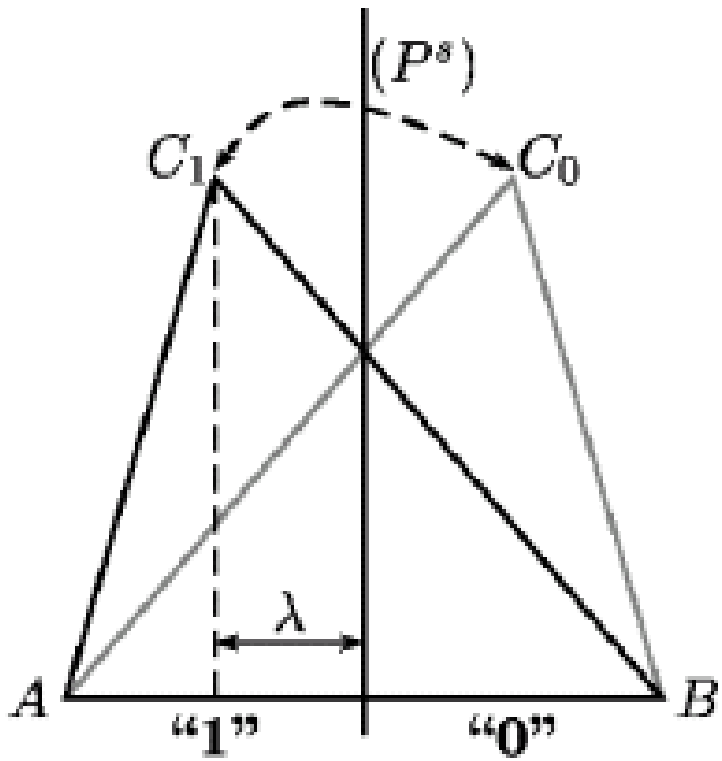
Proposed Method





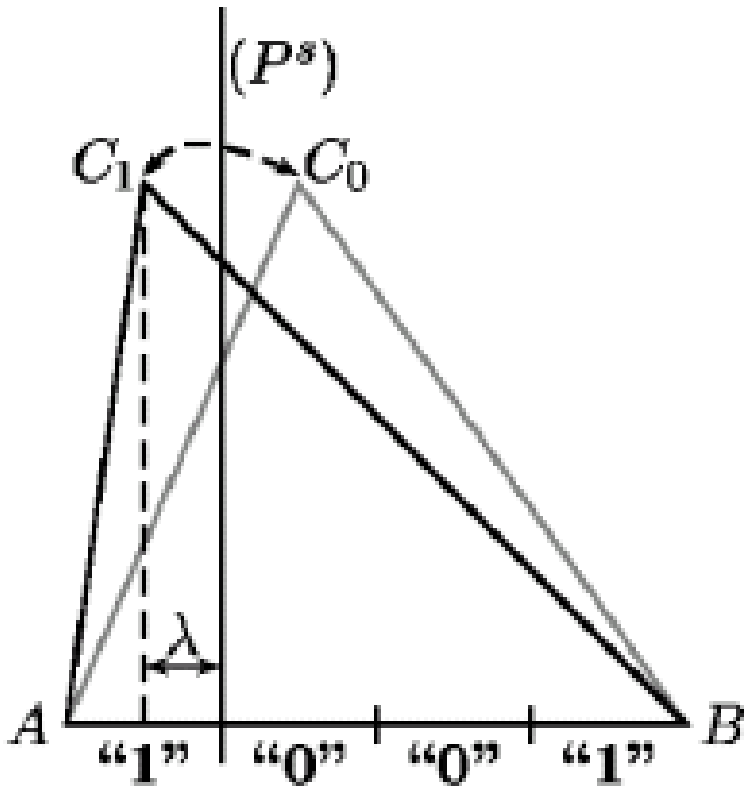
The basic idea
behind TPSS :
keep moving along triangles
and
add data to this triangles

Quantization - 1

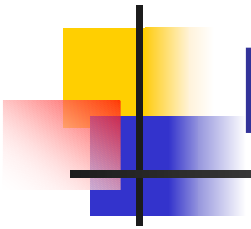


Base Quantization When n = 1

Quantization - 2



Base Quantization When n = 2

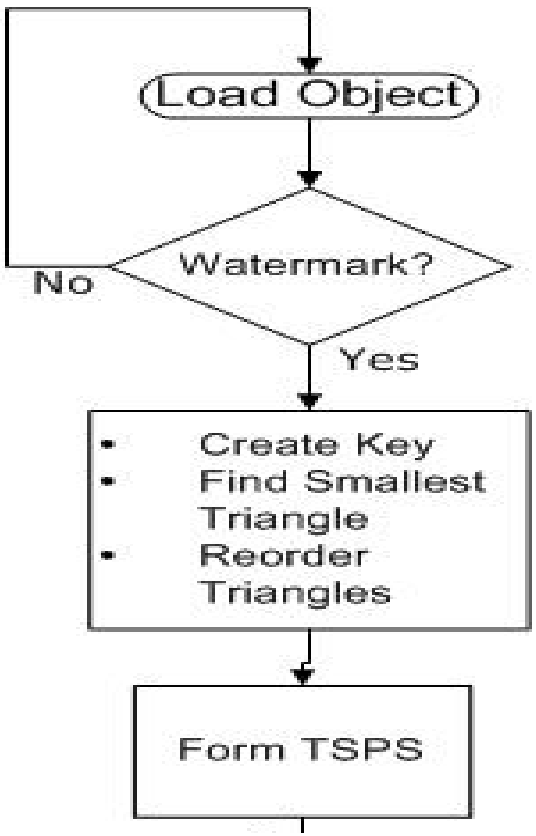


Hiding Data

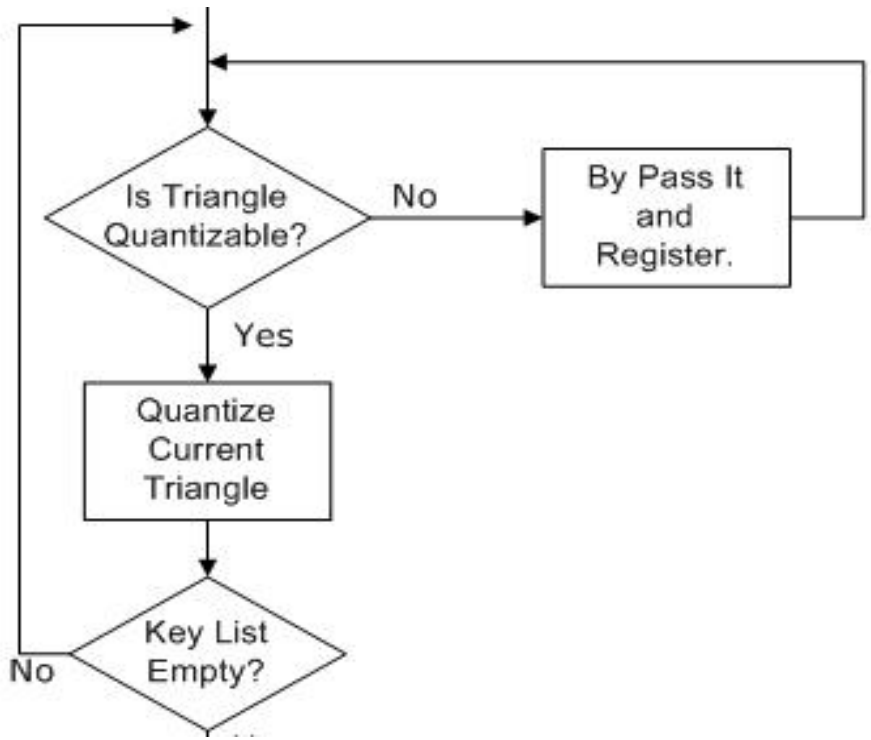
- Start Triangle to be determined:

  Choose the smallest triangle.
- Then data is hidden according to the "Key".

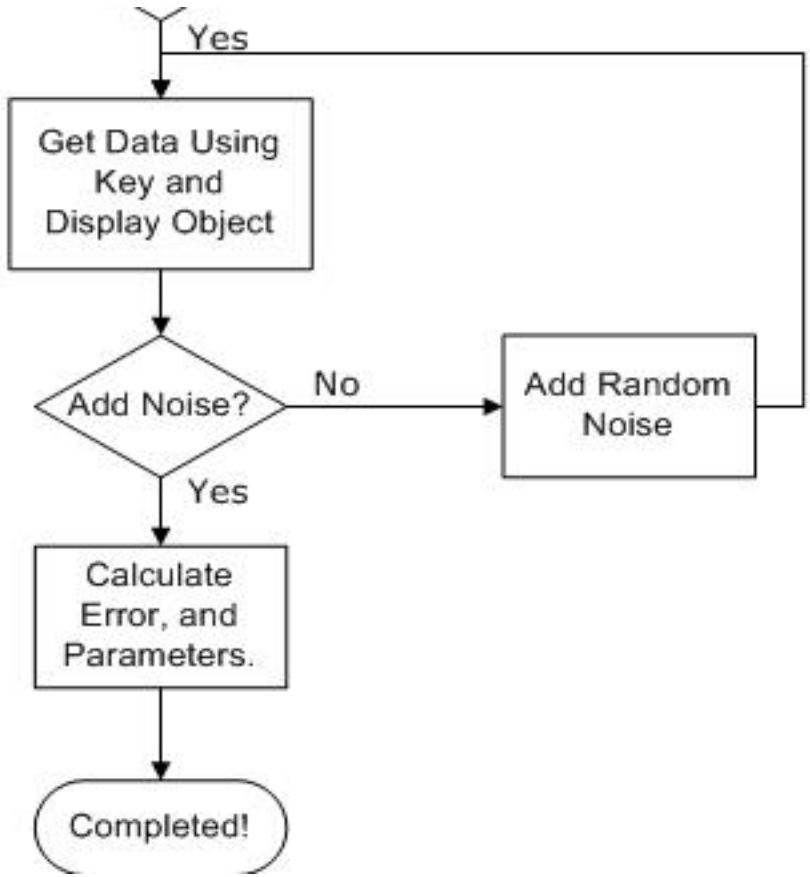
Algorithm - 1


Load Object
Watermark?
No
Yes
Create Key
Find Smallest Triangle
Reorder Triangles
Form TSPS

Algorithm - 2

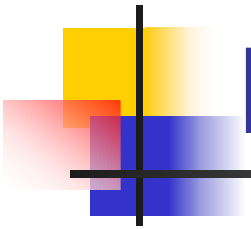

Is Triangle Quantizable?
No
By Pass It and Register.
Yes
Quantize Current Triangle
Key List Empty?
No

Algorithm - 3


Yes
Get Data Using Key and Display Object
Add Noise?
No
Add Random Noise
Yes
Calculate Error, and Parameters.
Completed!

Some Parameters

- Fill Rate $$R_{\text{fill}} = \frac{N_{\text{bits}}}{N_{\text{verts}}}$$
- Distortion Rate $$R_{\text{dist}} = \frac{\lambda_{\max}}{L_{\max}}.$$
- Coding Speed $$R_{\text{cod}} = \frac{N_{\text{Stencil}}}{N_{\text{bits}}}$$

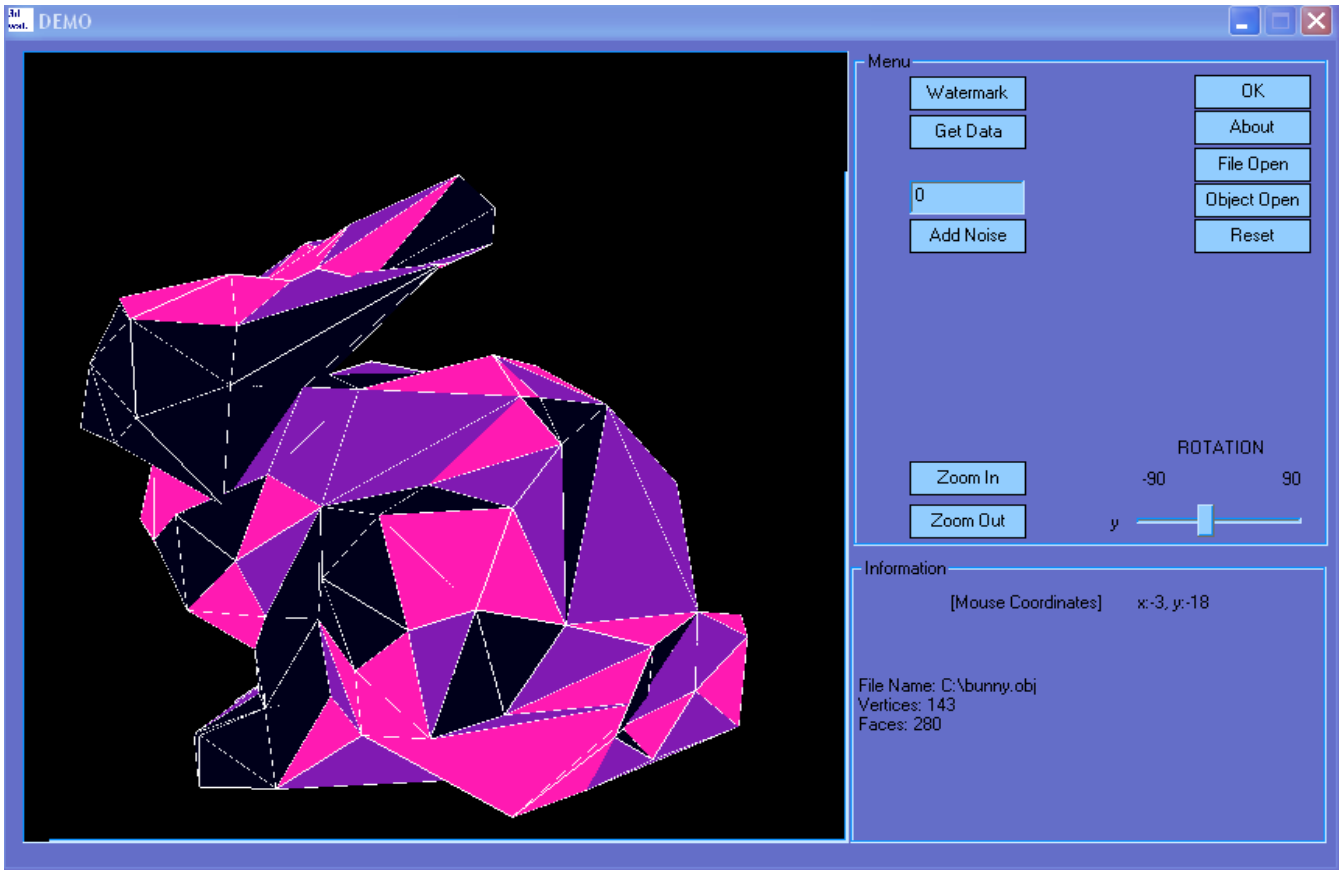


Demo - 1

- Our demo is a simple app. Showing practical usage of this method.
- Uses 3D Models.
- Adds random noise.
- Source Code:

  http://ieee.metu.edu/~teke/3DWat

Demo - 2



While the demo working