

## Master's thesis proposal

### 1. Title:

Signed distance field representation of polygonal meshes

### 2. Problem:

Polygonal meshes are popular in computer graphics but they have major drawbacks. They cannot accurately represent smooth shapes, their validity can be broken with holes and self intersections. Moreover, it only defines the surface of an object rather than the volume which makes certain operations very complicated if not impossible. Implicit functions and more generally FReps can represent volumes and perform complex operations more easily, but they are less natural to work with and user-control is more complicated.

Being able to use pre-existing polygonal mesh with the FRep functionalities require to generate a signed distance field function. This representation of the mesh would return the distance of any point in space to the closest point laying on the surface. Additionally, it will take negative values if the point is inside the surface, and positive if outside.

This problem has been partly solved, however it is often a performance bottleneck and problems may arise with open meshes, inverted normals. It is also often ++ avoid field discontinuities often present with discrete surface representations.

### 3. Objective:

The primary objective of this project is to produce and implement a fast algorithm (low complexity, parallelism) that can generate a continuous signed distance field. Additional features could include support for non-manifold meshes and inverted normals.

### 4. Product:

A C++ library with a demo (metamorphosis animation).

### 5. Applications:

The distance fields have many applications:

- Collision detections for cloth
- Shape modelling
- Metamorphosis - dramatic change of shape and topology over time
- CAD
- Sculpting

## Bibliography

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