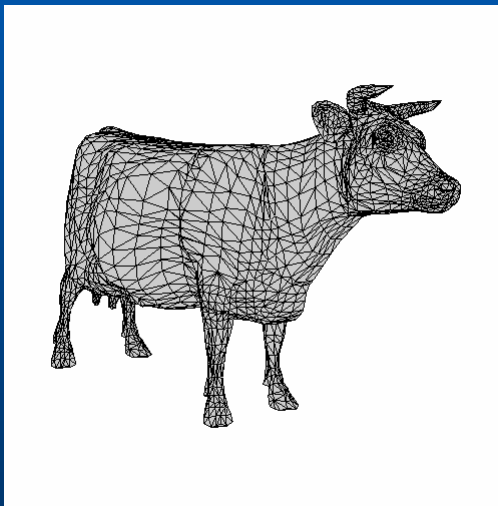# Decomposing Polygon Meshes for Interactive Applications

Xuetao Li, Tong Wing Woon, Tiow Seng Tan, Zhiyong Huang
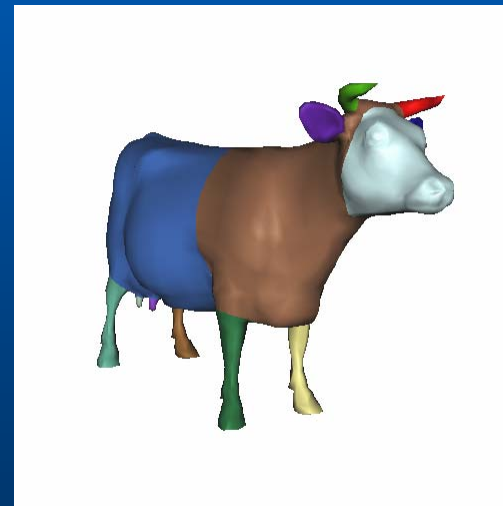
School of Computing

National University of Singapore

Objective

Automatically decompose a polygon mesh into meaningful components

Polygon Mesh   Decomposition

General Idea

Object

$$O = \bigcup_{t=t_{start}}^{t_{end}} G(t)$$

Decomposition

$$O = \{ C_i \mid C_i = \bigcup_{t=t_{ia}}^{t_{ib}} G(t), \quad i = 1, \dots, n \}$$
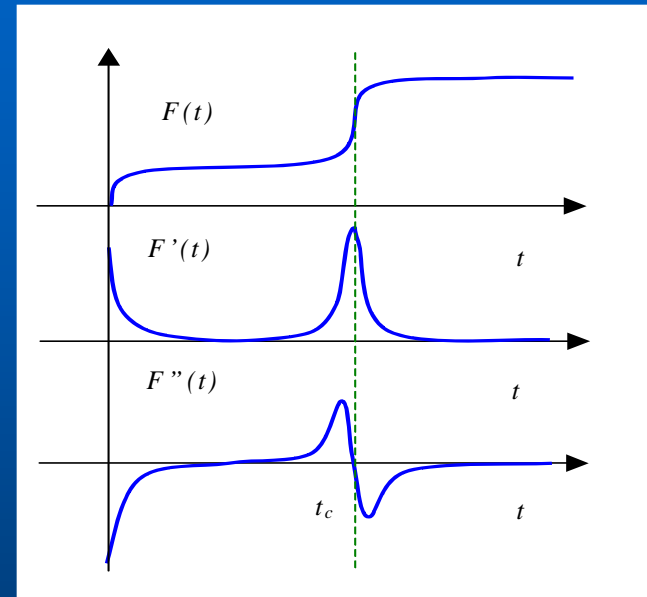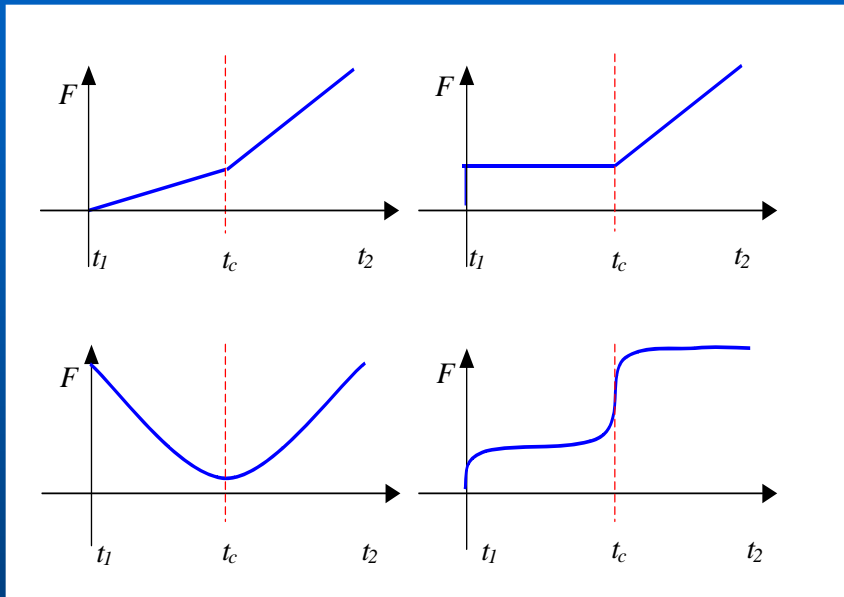
Geometric & Topological Functions

Geometric Function

$$F(t) = measure\ (G(t))$$

Topological Function

$$T(t) = \begin{cases} 0, & \text{topology of } G(t-\varepsilon) \text{ is different from } G(t) \\ 1, & \text{otherwise} \end{cases}$$
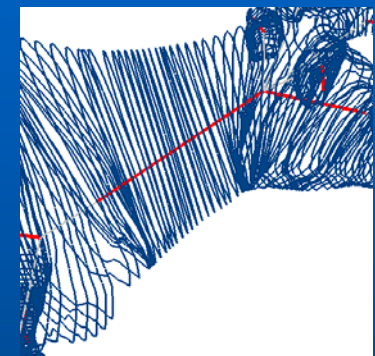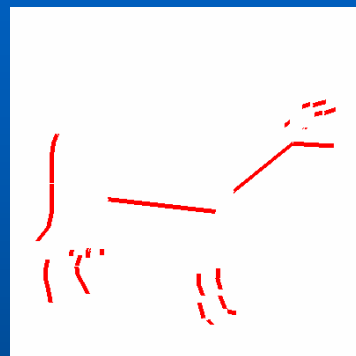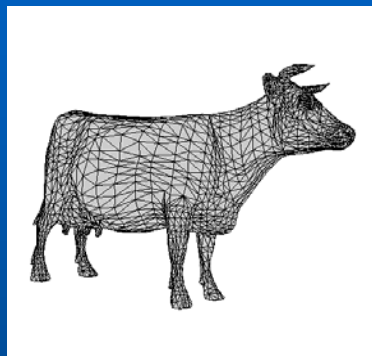
Definition of Component

Critical Point $(F^{(n)}(t) = 0 \text{ and } F^{(n)}(t - \varepsilon) \cdot F^{(n)}(t + \varepsilon) < 0) \text{ or } T(t) = 0$

Component $C = \bigcup\limits_{t = t_a}^{t_b} G(t), \text{ such that } \text{ there is no critical point in } (t_a, t_b)$

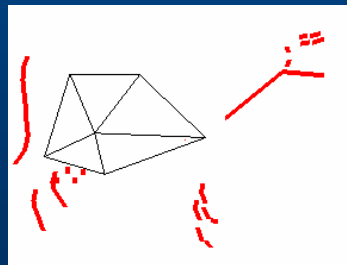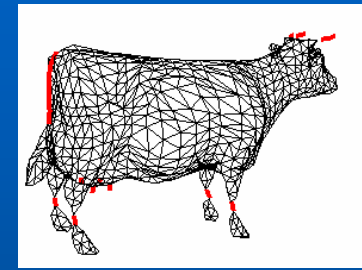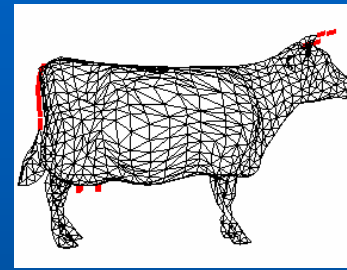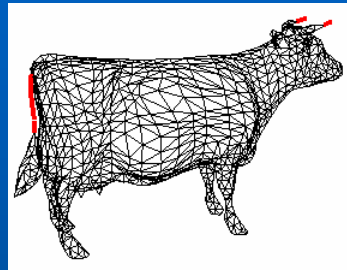# Approach

Computing Skeleton   **Defining sweep path**   **Space Sweeping**

Decomposition

Result
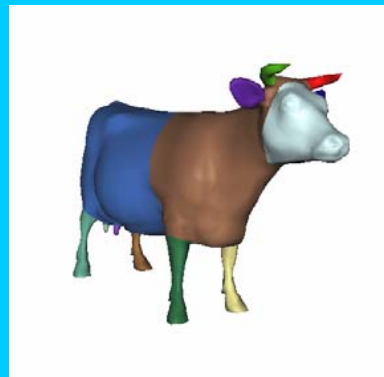
Skeletonization
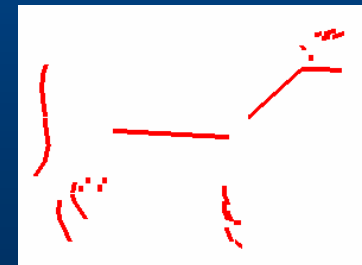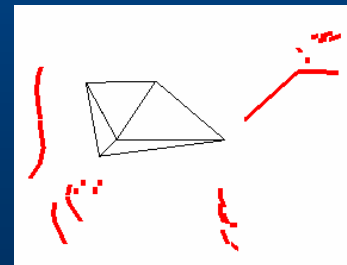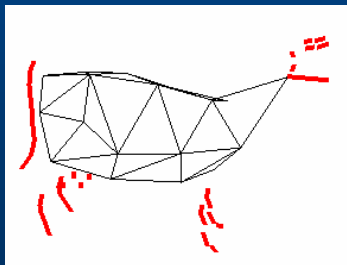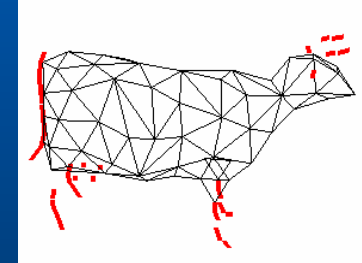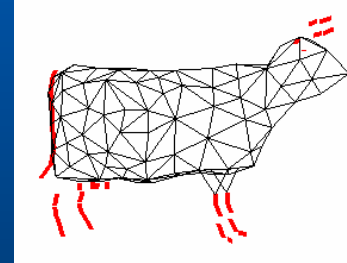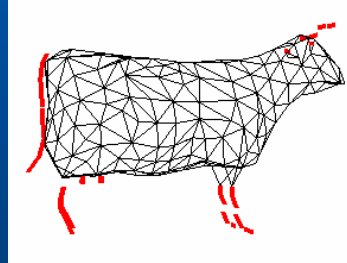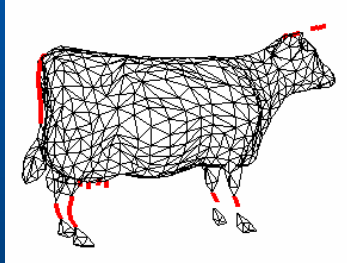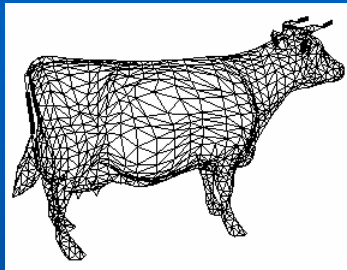
2D Example
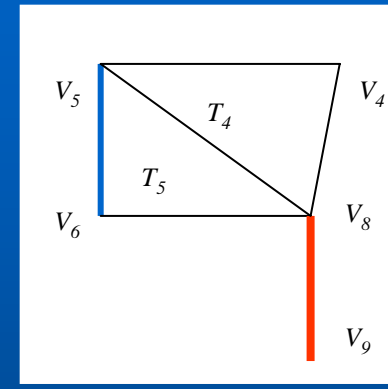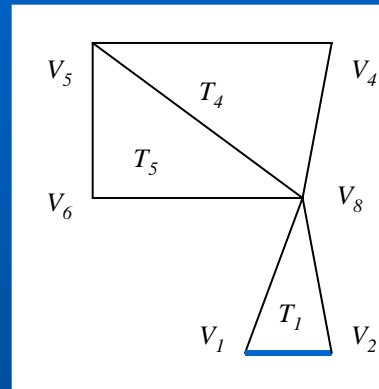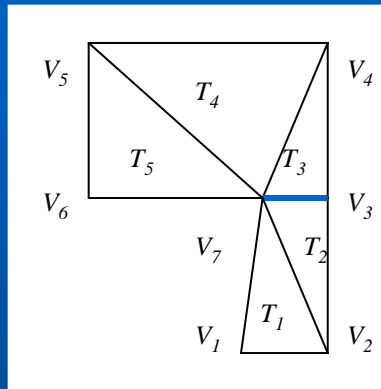
ATL(V_2,V_8) = { T_2 }
ATL(V_4,V_8) = { T_3 }
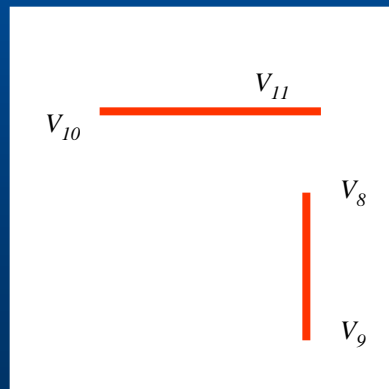
ATL(V_9 ,V_8) = { T_2 ,T_1 }
ATL(V_4 ,V_8) = { T_3 }
ATL(V_{10},V_8) = { T_5 }
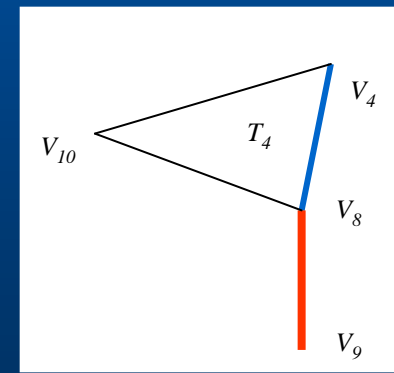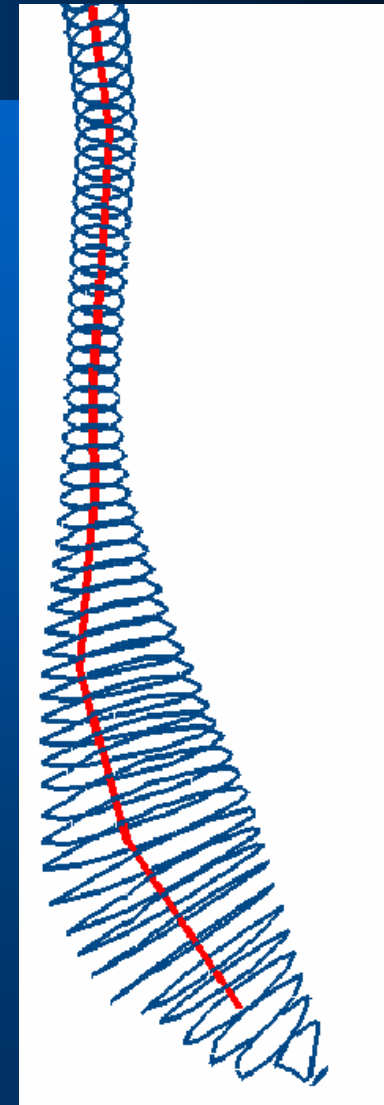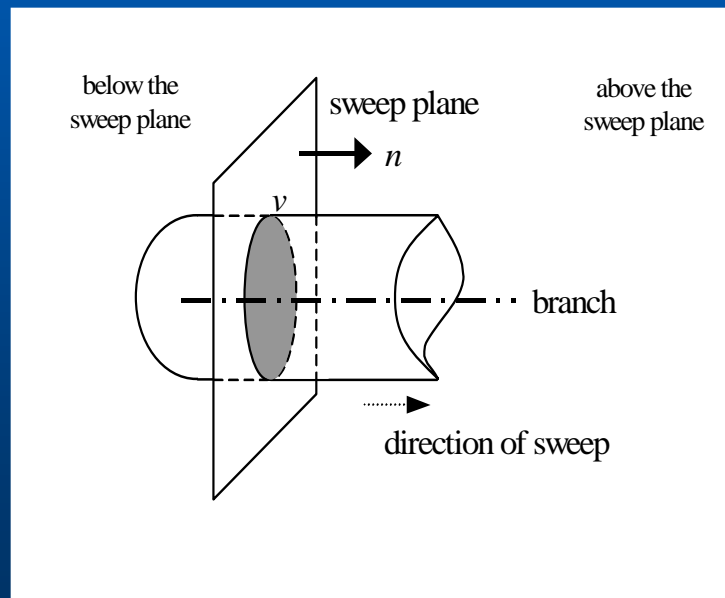
ATL(V_{10},V_{11}) = {T_5 ,T_4,T_3 }
ATL(V_9,V_8) = { T_2 ,T_1 }

Skeletal Tree
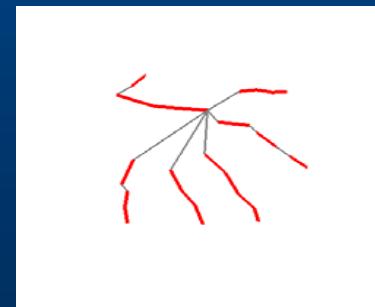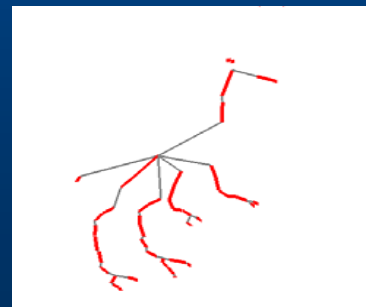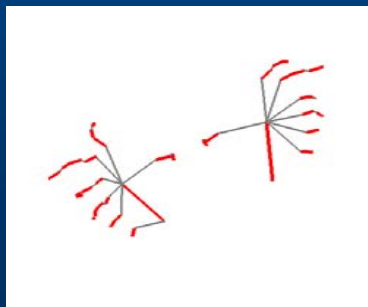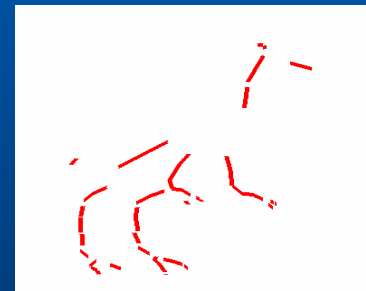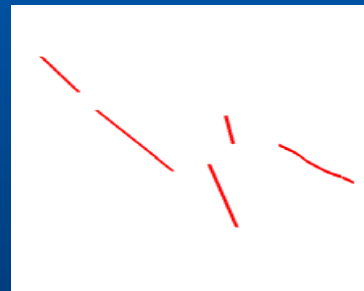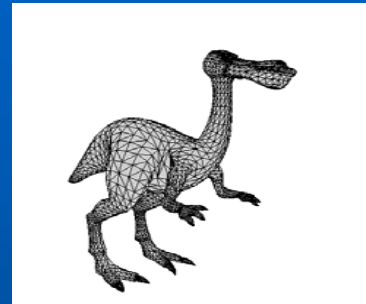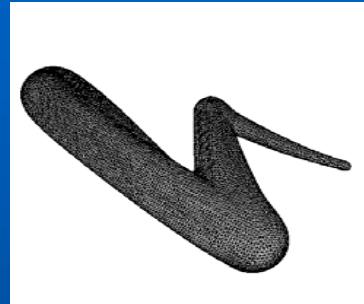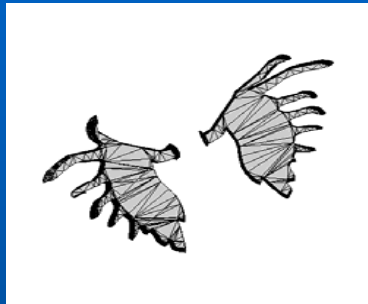
Sweeping Order

Space Sweep

below the sweep plane

sweep plane

above the sweep plane

n

v

branch
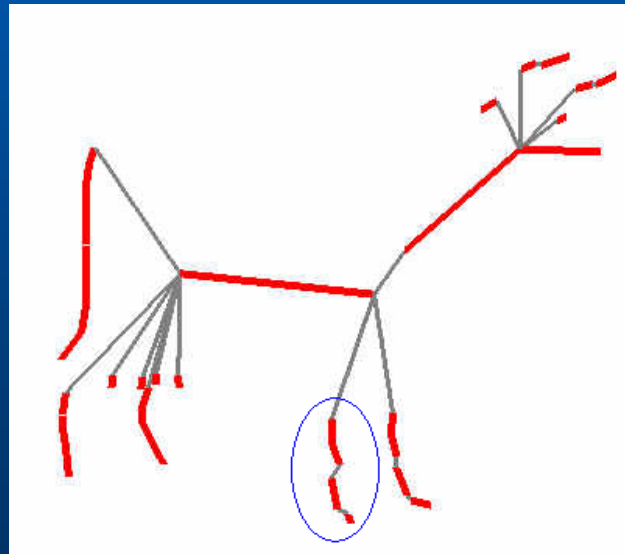
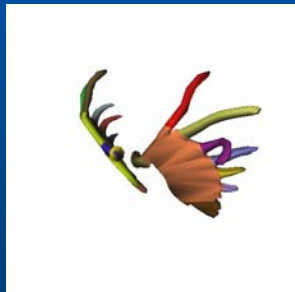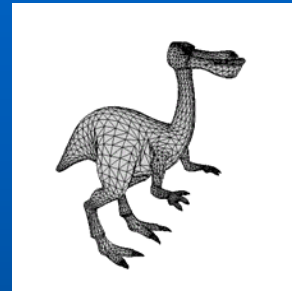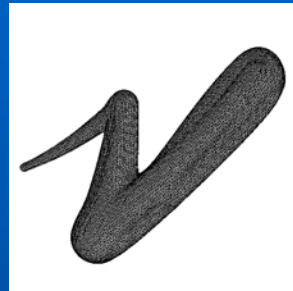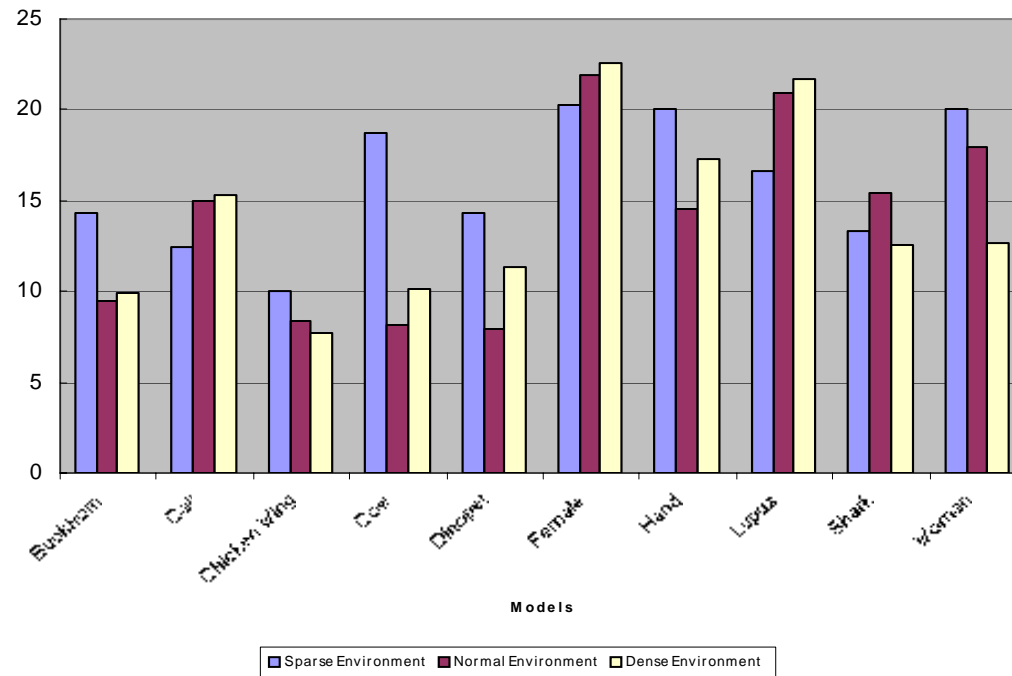direction of sweep

Extracting Component
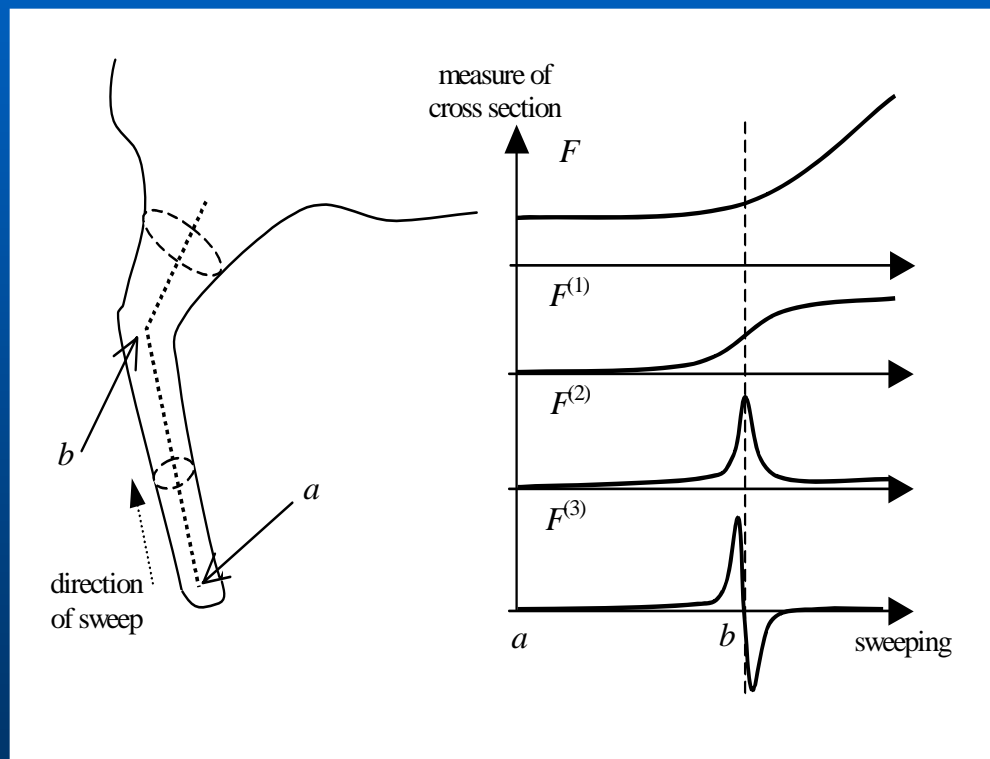
Decomposition Results
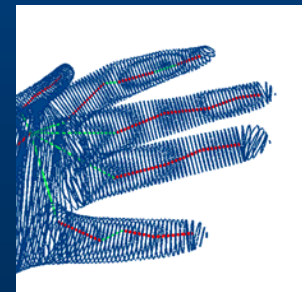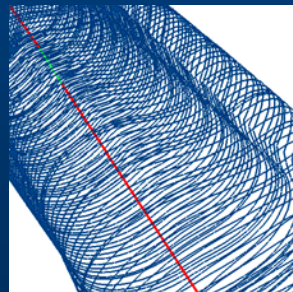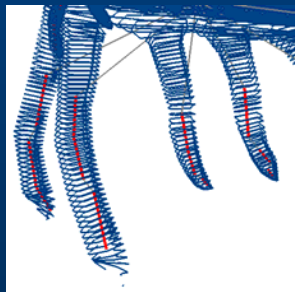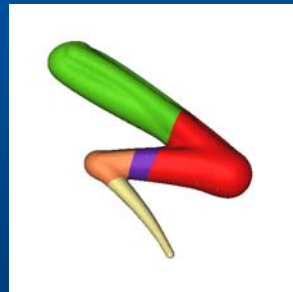
Application to Collision Detection

Conclusion

- **A formal definition of component**
- **A framework for decomposing polygon meshes**