INTRODUCTION

- Three-dimensional (3D) skeletonization provides an alternative to capture the inner structure of an overall complex 3D mesh by forming its own skeletons. These computed skeletons consist of significant geometric and topological information that are used extensively to produce segmentation for various analyses and visualization in medical imaging, robotics and video surveillance applications.
- The femur is the longest, heaviest and strongest bone in our human body.
- Different kinds of trauma with a lot of forces can damage this bone.

FEMORAL FRACTURES

CAUSES
- Higher-forces: Motor vehicle accidents, motorcycle crash
- Lower-forces: Fall from slippery floor, ladder landing on foot among the older people.

FRACTURES
- a) Simple
- b) Wedge
- c) Multifragmentary

TREATMENT
- ORIF (Open Reduction Internal Fixation) with intramedullary nailing

SEVERELY BOWED FEMUR
- mismatch between the intramedullary nail

3D PREOPERATIVE SIMULATION

- Mismatch problem of current available nail with bowed femur is a risk factor for anterior cortical perforation of the distal femur with subtrochanteric fractures, and leg length discrepancy with fractures of the femoral shaft.
- Therefore, an accurate and automatic 3D preoperative simulation are therefore desirable [3].

OBJECTIVE

- To develop an automatic approach with direct extraction of the skeleton from a 3D femur for each individual patient, in order to produce an accurate 3D preoperative simulation possible.

SKELETONIZATION USING MAX-MIN CENTER

1. Sliding process - the sliding window with appropriate height k is decided in the beginning. Then, the vertices in the sliding window are collected:
   \[ \mathcal{V}_k = \{ v \in \mathcal{V} : \| v \| < (i+k) \} \]
   where \( v = (x,v_x,v_y, v_z) \in \mathcal{V}, i = (i \times k), k \text{ is the step size}. \]
   2. Adjacent face \( \mathcal{F} \) : obtain the faces adjacent to the points in \( \mathcal{V}_k \):
   \[ \mathcal{F}_k = \{ \mathcal{F} \in \mathcal{F} : \mathcal{F} \subset \mathcal{V}_k \} \]

5. Weighted center point - calculate the weighted average of \( \mathcal{F}_k \):
   \[ \mathcal{F}_k = \frac{1}{N} \sum_{i=0}^{N} A_i \cdot \mathcal{F}_i \]
   where \( A_i = \sum_{j=0}^{N} A_i(j), A_i(j) = \text{area of a triangle } j, \text{ and } j = \text{center of a triangle } j. \)

6. Max-Min Center - \( B(p, r) \) is maximal circle to \( \mathcal{O}_k \)

FUTURE WORK

If a lot of relevant data is accumulated, we will develop a more efficient algorithm using Artificial Intelligence (AI) theory. The 3D femur skeletonization would give better understanding of the geometry and help to prepare and develop new intramedullary nailing system.

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