Morphometric Skull Analysis Using Jointed Chains of Rigid Bodies

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Research objectives: This work investigates two morphometric problems by applying the theory of shape-changing rigid-body mechanisms. The advantage of approaching morphometrics in this way is that a modest number of physical parameters describes the changes between the curves.

Morphometric skull analysis
Morphometrics seeks to quantify shapes for the purposes of comparison. Two morphometric problems are investigated. The first problem is the analysis of a head growth in children. The second problem is the spatiotemporal evolution of the longitudinal human skull shape. These problems are specified with a set of curves that represent the cranium shapes as they change over time, in the child’s head as it grows and in the skull as it evolves.

Rigid-body shape-changing mechanisms
A typical shape-change problem seeks a device that approximates a set of specified shapes with the edge geometries of some of its components.

Design methodology

- Start
- Design profiles
- Convert design profiles to target profiles
- Create initial segment matrix (SM)
- Create segments
- Fuse connections between segments
- Evaluate error of each segment
- Optimize SM
- Create segments based on the current SM and V
- Fuse connection between segments according to the current W
- Evaluate error of each segment
- Has the iteration time reached the limit or the error stopped reducing significantly?
- Minimum segment length α
- Use the virtual chain method to connect segments with revolute joints and satisfy end-link constraints
- Final chain
- Has a satisfying result been obtained?

Results

- Frontal suture
- Coronal suture
- Lambdoid suture
- Sliding part
- Fixed part
- Patella

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