3D ANALYSIS OF MOUSE EMBRYO BY X-RAY COMPUTED TOMOGRAPHY

Central European University
Kaucka Analysis

Additional volume of phosphotungstic acid

Organisms determination, study of mouse embryos

Nano Inspect and Foundation

and stages of cellular I

Segmentation

- manual

- automatic (segmentation algorithms, i.e. thresholding)

3D model creation

Data analysis

- Evaluation of various sample parameters (shape, size, volume)

- Wall Thickness analysis

- Fiber orientation analysis

Embryo staining

- phosphotungstic acid (PTA)

- Iodine solution

Comparison between automatic (yellow) and manual (green) segmentation. Scale bar 0.5 mm.

SHAPE COMPARISON

GDM imaging

This is used to compare the shape of the head between mutants and control embryos. The image show comparison at E12.5 developmental stage. Green color signifies no difference between the mutant and the control embryos.

VOLUME DETERMINATION – PORE / INCLUSION ANALYSIS

Head of 15.5 days old mouse embryo was scanned without staining in order to detect ossification centers in skull. Pore/inclusion analysis in VG Studio max 3.1 was used to evaluate interconnection and volume of ossified tissue. Colour scale defines volume of each connected system of ossified tissue.

WALL THICKNESS ANALYSIS

3D models and wall thickness analysis of chondrocraniums at different developmental stages. A) 3D models of nasal capsules created from segmentation of the raw microCT scans of mouse embryos at developmental stages E14.5 to E17.5. B) Analysis of the cartilaginous wall thickness of the whole chondrocraniums at E14.5 E17.5 developmental stages. C) Comparison of E14.5 nasal capsule inside of E17.5 nasal capsule.

FIBER ORIENTATION – EXTRAOCULAR MUSCLES

3D Visualization of extracocular muscles and eyeball with its lens at mouse embryo E18.5. To understand shape-making process and molecular mechanisms at cellular level, it is important to know exact angles and orientation of forming fiber muscles.

Visualization of different parts and/or organs

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Wall thickness analysis of chondrocraniums at different developmental stages

Wall thickness of mouse embryos

Fiber orientation analysis

Visualization of different internal systems

MicroCT was applied for visualization of vascular and biliary system after injection of two synthetic resins (MICROFIL®). Visualization in 3D enables to study architecture of systems and the data processing allows comprehensive evaluation of system parameters, i.e. volume, length or the number of bifurcations and interruptions.

VISUALIZATION OF DIFFERENT PARTS AND/OR ORGANS

Intact 15.5 days old mouse embryo was scanned in microCT device. Quality of resulting data enables segmentation of organs and inner structures, segmented regions can be further analyzed on wall thickness analysis and pore analysis. As an example liver, heart and kidneys were segmented.

3D PRINTING

Although several software-based methods for visualization of 3D data sets are available, having a solid model of the object under study provides additional opportunities to examine and understand the shape-organizing processes in the developing body. Here we show the full procedure of creating a real 3D object of mouse embryo nasal capsule, which includes scanning and microCT scanning combined with advanced data processing and 3D printing.

REFERENCES:


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