## Project concept

Latest version of Project concept: <https://github.com/andics/Big-Bang-Files.git>

The CT scans for this project are provided by the Bulgarian Academy of Sciences. The scanning was performed using an industrial µCT system Nikon XT H 225, developed by Nikon Metrology.

A typical skull dataset consists of multiple horizontal slice images at different heights along the whole skull. Looking at those images from the top of the skull to the bottom can be seen in dataset\_video.mp4. At the beginning of the video, a very long crack going through the middle of the image can be noticed. This crack is the sagittal suture, looked at from different horizontal slices. Now take a look at skull\_verticall\_view.png. Looking at the orientation of the bone on the image and imagining a horizontal slice going through the skull at that point, the images at the beginning of the video start to make more sense. A cross-sectional slice of the bone at a certain point is defined as an image, perpendicular to the surface at that point. A good example of such slice can be seen on the picture. Once we have that in mind, we can conclude that to see an image of the depth (thickness, cross-section) of the suture at a particular point, we would need a slice that is perpendicular to the surface at that point. This is clearly not the case with the top of the skull and the horizontal slices we are provided with. In fact, those horizontal slices are perfectly perpendicular to the surface at very few points on the skull, so we can’t directly extract our cross-sectional suture slices from the dataset needed for analyzing the sutures later.

For this reason, the first part of the project is to generate images perpendicular to the surface of the skull, in order to get a view of the bone cross-section. This is achieved by firstly generating a 3d model of the skull from the provided image volume. The suture’s start and end points are selected by the user on the 3d model. If the shape of the suture is more complex than just a straight line, the software allows for an unlimited number of points to define the length of the suture. The program then automatically generates images perpendicular to the surface of the skull along the length of the suture (between the start and end point). A good example of this ability can be seen in suture\_points.png. Preferences like the number of images wanted, or the size of the generated images can also be specified by the user.

The generated images are then exported to a specified folder, where they’re stored for future analysis.

The existing studies are only able to consider cross-sectional suture images at the top of the head, as the surface of the skull there is relatively flat. This allows for a vertical plane to generate multiple relatively cross-sectional images.

Even at this stage, the project already provides a better opportunity to analyze a suture, as it can generate cross-sectional images, not only at the top of the skull, but at any point of the skull (Unlike the [1] study).

Links to existing studies:

[1] Estimating age by assessing the ossification degree of cranial sutures with the aid of Flat-Panel-CT <https://www.legalmedicinejournal.com/article/S1344-6223(09)00112-6/fulltext>

[2] High-resolution flat-panel volumetric CT images show no correlation between human age and sagittal suture obliteration—Independent of sex

<https://www.sciencedirect.com/science/article/pii/S0379073810001787>

[3] Age estimation by multidetector CT images of the sagittal suture

https://link.springer.com/article/10.1007/s00414-013-0883-y