The accurate age estimation is a substantial part of the integral biological profile, but quite complex in cases of unidentified decomposed and skeletonized human remains, especially in adults. Commonly, the skull is well-preserved and due to the cranial sutures ossifying in conjunction with age, the patency of contact between adjacent calvarial bones has been used for an age-at-death prediction in the bioarchaeological and forensic expertises.

Until now, the correlation between suture closure and age-at-death (AAD) has been examined by methods based on subjective assessment of the suture surface, using descriptive rank- ordered scoring scales of various grades.

This project is aimed to elaborate an algorithm for objective automatic assessment of the suture closure degree in cross-section and to assess its relation to aging. For the purpose, I’ve used volumetric images (.TIFF) of dry skulls generated by an industrial μCT system. The obtained spatial resolution (voxel size of 97.5 μm for μCT) was high enough to allow precise detection of the suture using a semantic segmentation neural network with accuracy of 91%. The segmented suture area is processed using adaptive thresholding and C-Means clustering, which provides a number of important metrics used to describe the degree of suture fusion. Such metrics have been recorded and analyzed for a population of adult male skulls with known age-at-death. I managed to prove a statistically significant correlation between the measured by the algorithm variables and AAD, which is something that has never been done with the help of a computer algorithm so far. Furthermore, I’ve found a regression equation which relates the algorithm’s measurements with the age-at-death of an individual. I’ve tested the prediction accuracy of the regression on an independent sample of skulls and managed to reduce the error of the predicted AADs over 3 times compared to the already exist methods for AAD estimation based on cranial suture analysis.

The project saves human resources by completely automatizing the process of cranial suture assessment and provides a significantly more accurate age prediction than the existing methods in the field. Overall, this improvement is an important advancement in the fields of forensic science and archaeology, as it introduces a new objective and automatic method for age estimation in cases of unidentified skeletal remains.