A Novel Method for Skeletal Age Estimation Based on Cranial Suture Analysis

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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 suture ossification in conjunction with age, the patency of contact between adjacent calvarial bones has been used for an age-at-death (AAD) prediction in the bioarchaeological and forensic expertises. This project's aim is to objectify and improve the accuracy of age estimation methods based on cranial suture analysis by elaborating an algorithm for automatic assessment of the suture closure degree in cross-section and assessing its relation to aging. For this purpose, I have used volumetric images of dry skulls generated by an industrial micro-CT system and processed them using deep learning and C-Means clustering. Those algorithms provide a number of important metrics used to describe the degree of fusion along the suture length. Such metrics have been recorded and analyzed for a population of adult male skulls with known age-at-death. I have found a regression equation which relates the algorithm's measurements to the age-at-death of an individual and tested its prediction accuracy on an independent sample of skulls. The algorithm managed to reduce the error of the predicted AADs over 3 times compared to the already existing methods for AAD estimation based on cranial suture analysis. In conclusion, the project completely automatizes the process of cranial suture assessment and provides a significantly more accurate age prediction than any of the existing methods in the field.

Awards Won:
Arizona State University: Arizona State University Intel ISEF Scholarship