

# **Morphometric approach to 3D soft-tissue craniofacial analysis and classification of ethnicity, sex, and age**

## **ABSTRACT**

**Background:** The application of three-dimensional scan models offers a useful resource for studying craniofacial variation. The complex mathematical analysis for facial point acquisition in three-dimensional models has made many craniofacial assessments laborious. **Method:** This study investigates three-dimensional (3D) soft-tissue craniofacial variation, with relation to ethnicity, sex and age variables in British and Irish white Europeans. This utilizes a geometric morphometric approach on a subsampled dataset comprising 292 scans, taken from a Liverpool-York Head Model database. Shape variation and analysis of each variable are tested using 20 anchor anatomical landmarks and 480 sliding semi-landmarks. **Results:** Significant ethnicity, sex, and age differences are observed for measurement covering major aspects of the craniofacial shape. The ethnicity shows subtle significant differences compared to sex and age; even though it presents the lowest classification accuracy. The magnitude of dimorphism in sex is revealed in the facial, nasal and crania measurement. Significant shape differences are also seen at each age group, with some distinct dimorphic features present in the age groups. **Conclusions:** The patterns of shape variation show that white British individuals have a more rounded head shape, whereas white Irish individuals have a narrower head shape. White British persons also demonstrate higher classification accuracy. Regarding sex patterns, males are relatively larger than females, especially in the mouth and nasal regions. Females presented with higher classification accuracy than males. The differences in the chin, mouth, nose, crania, and forehead emerge from different growth rates between the groups. Classification accuracy is best for children and senior adult age groups.