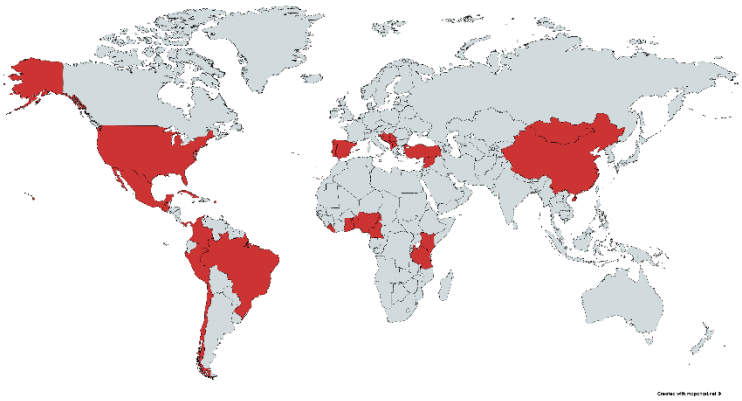
Moving Knowledge from Research to Impact

SUCCESS STORY

NIJ and North Carolina State University

Uncovering Key Details of Skeletal Remains through 3D-ID Software



"3D-ID has been an invaluable tool for us. Many of our unknown persons come from populations south of the Border. We use this program for every case with great success. It has also been a great tool to combine with chemical isotope data, providing a very accurate and powerful result, even in the most complex cases."

—Erin Kimmerle, PhD
Director, Florida Institute of Forensic Anthropology and Applied Science (IFAAS), University of Florida

Problem and Solution

When forensic anthropologists investigate unidentified remains, they look for important clues that can help identify the subject. For example, the size and shape of the skull can be used to predict a subject's ancestry and sex, details that can play a key role in narrowing down the identity of the decedent.

Traditionally, the methods used to characterize the shape and size of a skull involve multivariate statistical analysis techniques that measure disparate linear distances between anatomical landmarks on the skull. However, this approach provides limited information on the shape of the skull, as these linear distances are measured in two dimensions and not in relation to other measurements.

Geometric morphometric (GM) analysis records the same anatomical landmarks, but in relation to each other in three dimensions (X,Y,Z coordinates), providing a more biologically informative perspective of the skull that can better characterize the form (i.e., both shape and size) of the skull.

GM uses archive or reference data to compare standard coordinate data and, thereby, estimate sex and ancestry for unknown individuals. The use of GM is challenging, however, as the coordinate data associated with the anatomical landmarks must be standardized for direct comparison, which requires additional analysis. While valuable, this technique has not been used commonly in forensic anthropology.

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To drive the application of GM analysis in forensic anthropology, Dr. Ann Ross and Dr. Dennis Slice developed 3D-ID, a no-cost software that enables the forensic anthropologist to estimate sex and ancestry for unknown crania using GM methods. These estimations are made by comparing coordinate data obtained from unknown crania to those of a collection of reference samples procured from forensic casework, museums, and collaborators. The software automatically standardizes the coordinate data from the GM measurements, simplifying analysis and saving time for the practitioner. 3D-ID offers a higher level of detail for ancestry and sex predictions from skeletal remains compared to traditional measurement of unknown crania, while being accessible and easy to use.

Using 3D-ID allows identification to move away from simplistic race-based classifications to groupings of individuals based on traits within specific geographic locations. Reference sets for 3D-ID reflect a diverse set of populations. The software was released in 2009, with a second release in 2014 following the addition of 1,000 individual samples of European origin and a 2018 release incorporating samples from Colombia, Angola, Benin, Ghana, Cameroon, Togo, Liberia, and Syria.

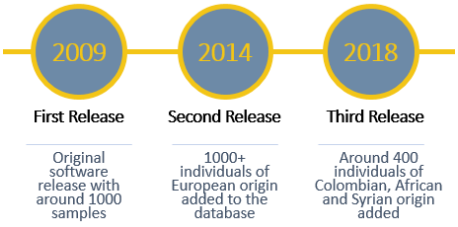

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Image Credits
Page 1—MapChart

Key Benefits

- Reference samples account for human variation between sexes and individuals of various geographic origins, enabling forensic anthropologists to detect small shape differences within and between closely related populations. This improves the ability of the practitioner to pinpoint the identity of the individual.
- This robust software allows practitioners to glean key details from crania, even when they are fragmented or incomplete.
- This easily accessible software is user friendly: it uses methods that measure the same anatomical landmarks as in traditional craniometrics and automatically standardizes the coordinate data.

NIJ-Funded Research

NIJ support facilitated this interdisciplinary collaboration (award 2005-MU-BX-K078) among anthropology, computer science, and statistics researchers from North Carolina State University and Florida State University. This team collaborated to build 3D-ID, and has continued to add to this open-access software by expanding the reference data set.

Bringing Research to Practice

- The reference set has been expanded to more than 2,300 individual crania, demonstrating that large variations exist within geographic regions.
- This no-cost software is accessible to the public on the 3D-ID website and can be downloaded on any computer running Java 1.5 or later.
- The National Forensic Science Technology Center organized an "Advances in Forensic Anthropology" Technology Transition Workshop, which included training on 3D-ID and can be found here. Valuable tips for using 3D-ID can also be found in the NIJ final report.
- 3D-ID is compatible with MicroScribe digitizer software, allowing users to digitize directly into 3D-ID.
- An update regarding the newest features of 3D-ID is provided in this FTCoE webinar.

The Future

- Dr. Ross will characterize Nigerian samples, potentially separately from samples from the country's geographic neighbors; Nigerian crania have been shown to exhibit significant variation relative to those from other West African countries. African samples from Angola and Gabon, and a Guatemalan sample from Central America, are currently undergoing validation and will be included in early 2019.
- The research team aims to leverage community input to identify additional landmarks that can be included in analyses using 3D-ID.
- Finally, the team also hopes to continue to add reference samples for regions severely affected by current and potential future migrant crises.

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