Dead Men Do Tell Tales: How computers can help us hear them

Jessica Lam explains how forensic anthropology and computer science can work together to identify and recover information from dead bodies. As she puts it, whenever we deal with the dead, we remember the living.

Establishing the Identity of the Dead

Although "death investigation" is quite a clinical and detached term, forensic anthropologists know better than to ignore or push aside the human aspect of this kind of work. How we deal with death is part of what makes us human, from a philosophical and societal point of view. For that reason, whenever we deal with the dead, we remember the living.

Legally, a death investigation is mandated when an individual has died in suspicious or unnatural circumstances. The point of such an investigation is to determine the cause of death, and this task is usually given to the coroner, who works with a forensic pathologist. But sometimes, there is more to a death investigation – what if we don't know who the person was to begin with? The identity of the deceased is crucial for many reasons – enacting the will of the deceased, contacting family members and loved ones, and if there is a criminal aspect involved, reconstructing the events surrounding the death.

Establishing this can be problematic if the body has decomposed, or if there were attempts at disfiguring and hiding the identity. In these cases, the most robust piece of evidence left is the skeleton. Bone is tough and persists throughout time even if it has been subject to harsh conditions, this is where forensic anthropologists come in.

From bone, forensic anthropologists build the "biological profile" by analyzing the skeleton to produce assessments of biological sex, age, and ancestry, in the hopes that missing person profiles can potentially match, and the dead can be identified. Forensic anthropologists analyze the shape and form of bone, both visually and through measurements. Then, based on population-specific knowledge of how the skeleton grows and degenerates throughout life, and how these changes are different between males and females, it is possible to understand the identity of the deceased individual.

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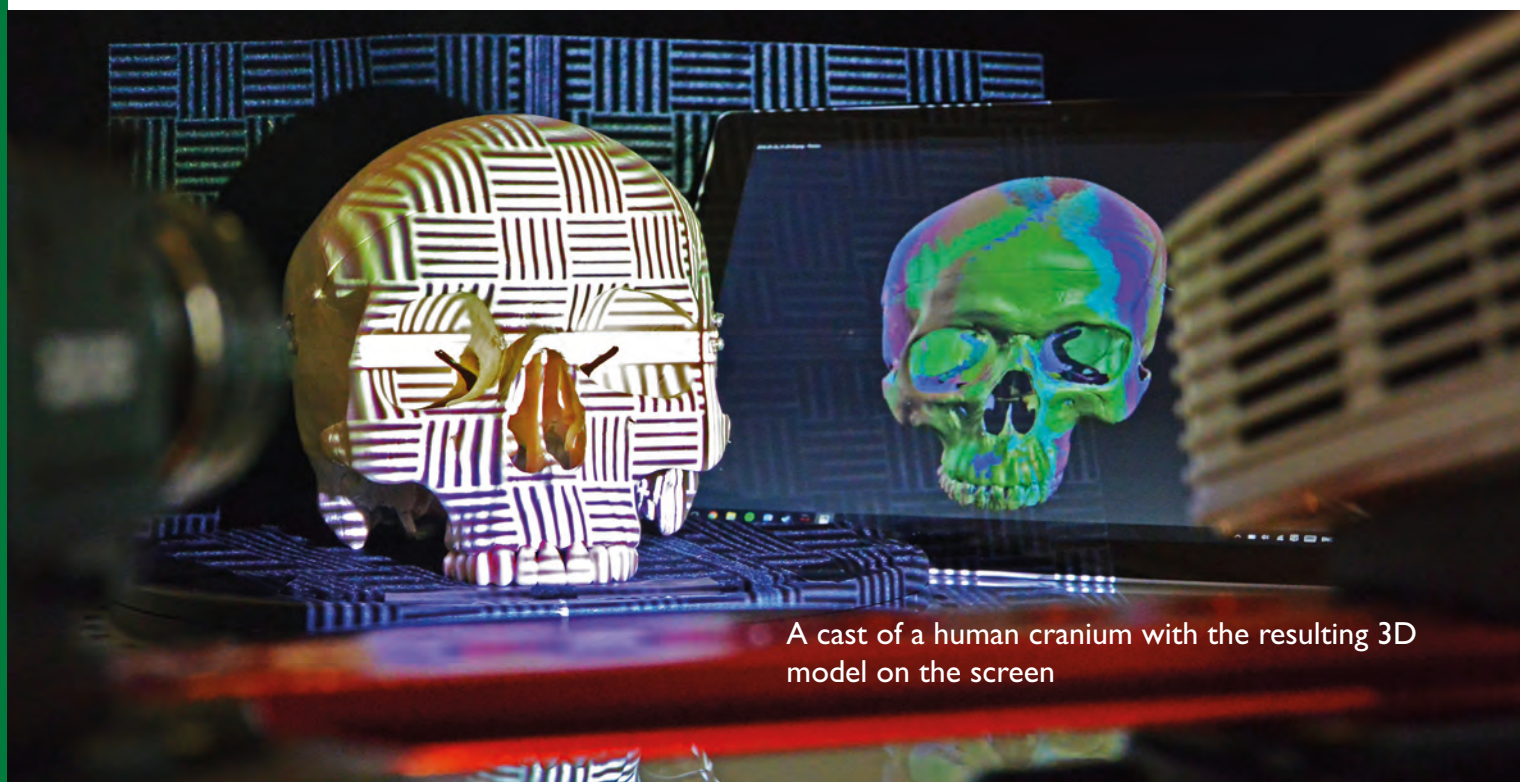
Using Computer Programs to Analyze Data

As with anything humans do, there is bias, and to date there has not been a single skeletal assessment method that can be replicated with 100% reliability and accuracy. This is because people tend to see things differently, even if the same bone is analyzed. For example, bones may be measured differently because analysts



A cast of a human cranium with the resulting 3D model on the screen

Jessica in the Bone Lab at the University of Leicester with casts of human skulls.

understand or choose bony landmarks in slightly different ways. This is problematic, because the results may differ considerably. As scientists, we want to ascertain the absolute truth. As a judge or a jury member, we want to be reassured that the methods used in a criminal investigation are reliable. This is where computer programs come into play.

Computer programs are reliable in the sense that if you input the same things, you will always get a consistent answer (unless randomization is built into the computer's algorithm). This is both an asset and a weakness – it certainly solves the issue of reliability and repeatability, but humans also distrust answers from "black boxes", which simply means, if you input something, you'll get an output. What happens in the "black box" in order to get the answer is not verified. An example of this is a program that takes inputted measurements and creates an equation that says how likely the measured bones belong to a male or a female, and from which population. The program will still give an answer even if the group that the individual actually belongs to is not one of the available options. By forcing the individual into one of several pre-defined groups, the program itself shows bias.

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The Human Component in Forensic Science

There is a need for humans to check over answers to ensure that the outputs from programs make sense. Society also needs to understand how humans can learn from programs, and how programs can complement a human's analysis. This is what my research focuses on. I am creating a database of 3D models of skulls and writing a program that can automatically define the important features for identifying the biological sex and population from which the individual comes. The program I am creating may identify patterns that humans have not yet recognized, and if this is the case, then we have a lot of new and exciting avenues of research to pursue in order to understand the theories underlying these patterns.

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There is also an important social aspect to human work in death investigations, which is why, from this point of view, computers should not be taking over the entire task of identifying the dead. Human interaction with the dead is a concept that is strongly prevalent in all societies across time and space, although the nature of this interaction differs remarkably. By preserving this human component in death investigations and using programs to augment this work, the task of identifying the dead can become more robust while remaining an important part of society.

Jessica Lam is completing her PhD as part of the INTREPID Forensics Programme