Robotic Archaeology

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In an intriguing juxtaposition of ancient and modern technologies, Evan Ackerman reports on the use of a robotic arm by Radu Iovita, Jonas Buchli, and Johannes Pfleging to undertake use-wear analysis of stone tools. The accompanying video shows the robot arm using a stone tool on different materials (hide, wood, stone) and, rather neatly, every 50 scrapes it automatically turns to a microscope to capture an image of the developing wear pattern on the stone tool. Ackerman's source is a piece by Samuel Schlaefli which contains more background and information about the project. For instance, the robot arm is able to adapt the force it applies in response to the resistance it detects, and the ability to run the experiments 24 hours a day, potentially using multiple robotic arms working simultaneously, is said to enable the creation of massive databases and consequently accelerate the production of knowledge in archaeology and palaeoanthropology about use wear patterns on stone tools.

Schlaefli quotes Iovita: " … a generational and paradigm shift is currently underway … The interest in automated analysis is growing and more and more archaeologists have access to the relevant technology" and Buchli: "In 10 years' time, robotic analysis will be the standard in archaeology … For the first time, research results would be truly comparable because the methodology behind it is standardised and the devices properly calibrated."

This sensitive, adaptive approach to robotics development is underlined by research into printable, synthetic, sensitive skin for robot hands that is capable of sensing texture, heat, and other material properties, and with feeling and dexterity enough to detect types of clothing and fold them

appropriately. In that light, how long before someone rigs one up in the field and teaches it to trowel on an archaeological excavation? After all, it could potentially work 24 hours a day, no tea breaks, using photographically-derived image-based modelling to record its encounters with archaeological features. Or maybe not.

So far, so interesting. But what is as interesting is some of the language surrounding the original story. For instance, the title of the *IEEE Spectrum* piece itself: 'Robot Arm Brings Humanity Back to the Stone Age', is not as ironic as it at first seems.

Ackerman worries over the question of what 'manual' really means in this context, and concludes that it's perfectly reasonable to see the robotic motions as manual since "it's precisely replicating the motions and forces generate by a human hand". Is it really? Although he suggests that some randomness could be introduced to make the object appear more handmade, what he really seems concerned about is the final appearance of the whole object, whereas the specific focus of the experiment is the use wear patterns on the surface of the artefact. The creation of these surely needs to be underpinned by a complex model to replicate human action – different directions of movement, different angles of attack, different degrees of pressure etc. to map human variability brought on by fatigue, boredom, sensitivity to the material, levels of concentration, and so on.

But then who am I to question this? Use-wear analysis is not my field, nor is robotics. Indeed, Schlaefli writes of opposition experienced over the relevance of robotic 'manual' recording and the overall value of use wear analysis, and claims that "Iovita thinks this is mainly due to the fact that most archaeologists have a humanities background and are not familiar with the world of engineers." Hmm …

Coincidentally, a month after Schlaefli's article appeared, Malcolm Gladwell describes how engineers see the world very differently and, constrained by specifications and tolerances, lack empathy for users who disagree with the imperfections and compromises in the technologies they create. For example: "A pessimist sees the glass as half empty. An optimist sees the glass as half full. The engineer sees the glass as twice the size it needs to be." The realisation that engineers needed to think like their users and understand their perspectives led to a radical shift in approach in the Toyota car safety case from 2009-10 that Gladwell describes. So the world of engineers should perhaps familiarise themselves with that of the humanities?

Setting aside the compounding of stereotypes and the apparent characterisation that most archaeologists lack a scientific outlook, what is wrong with someone with a humanities background asking questions about the application of technology – be it robotics or computing technology more generally? After all, it is effectively a definition of at least one aspect of digital humanities: the asking of traditional kinds of humanities-oriented questions about computing technologies (for example, Kathleen Fitzpatrick 2010). Todd Presner (2010) suggests that "the central work of the humanities—creation, interpretation, critique, comparative analysis, historical and cultural contextualization—is absolutely essential as our cultural forms migrate to digital formats and new cultural forms are produced that are 'natively digital'." In some respects, therefore, humanities-based critiques of technology should be the equivalent of 'speaking truth to power'. Consequently archaeologists with a humanities background have a responsibility to understand enough about the principles underlying our technological tools in order to be able to use, question, and challenge them intelligently.

At the end of his article, Ackerman muses about whether the meaning of ‘handmade’ is changed if a robot can exactly replicate an object such that it couldn’t be determined from one made by a human, in a kind of material version of the Turing Test. Of course, ‘handbuilt by robots’ was the tag line of a famous advertisement for the Fiat Strada car by Hugh Hudson, the irony there being that when he and his team arrived to film at the Fiat factory, it was on strike with workers protesting about their jobs being taken by robots. So the controversy about the relationship between human work and robots is nothing new – and nor, for that matter, is the debate about the authority and critique of technology …

References

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