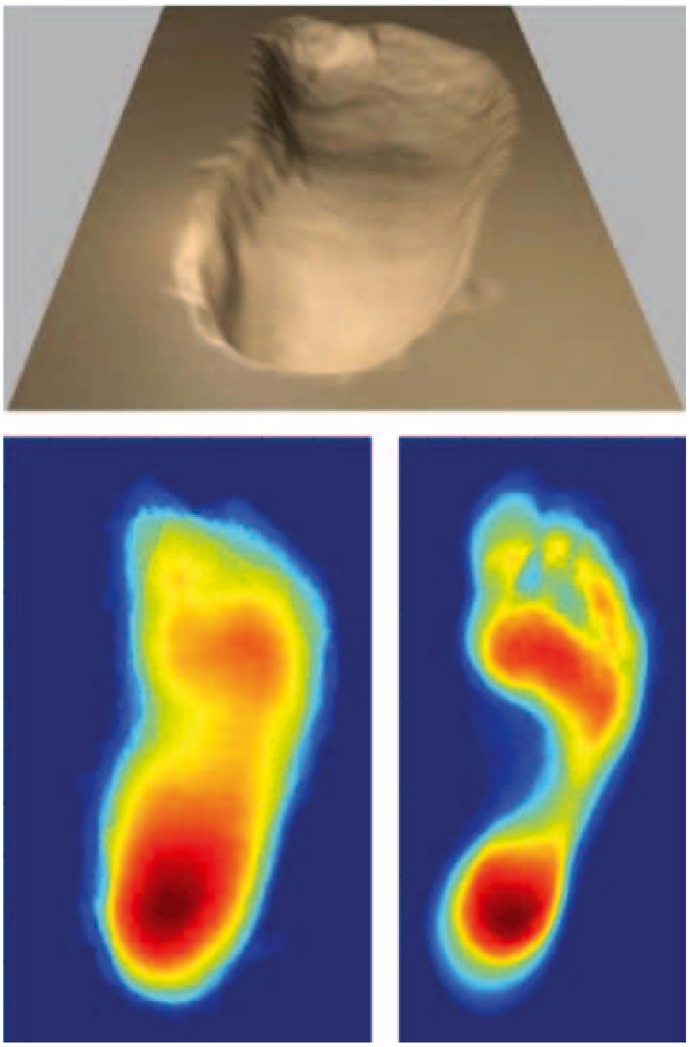

Top: 3-D image of a Laetoli footprint. MRI scan of a Laetoli footprint (left) and a modern human footprint (right) in false-colour. The warmer the colours, the greater the depth.

Evolutionary Morphology and Biomechanics Research Group, University of Liverpool

Robin Crompton from the University of Liverpool explains how techniques developed to study ancient footprints will have direct applications for modern life.

Best foot forward

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Our human ancestors have been walking much as we do for nearly four million years – nearly two million years before the date of appearance of our own genus, *Homo*.

This was our clear and surprising finding when we studied a trail of 3.66-million-year-old footprints from Laetoli, Tanzania. And if you're wondering why you should care about this revelation think again, because the techniques we developed along the way to making this discovery have immediate clinical, forensic and security applications too.

Footprints contain direct evidence of how the foot drives, brakes and balances the body. But they are difficult to measure and analyse, because they are made, not by hard bones, but by layers of soft, deformable tissue, pressing into soft, deformable ground surfaces. There are no reliable 'landmark' points between which measurements can be made, and even the same individual's feet may contact the ground slightly differently at each step.

As luck would have it, when I put my research team together the best candidate for post-doc researcher had previously been studying brain function through imaging techniques like MRI (magnetic resonance imaging) scans. We quickly realised the problems of analysis were very similar: both have to contend with fields of data that vary 'smoothly', without landmarks or abrupt changes to provide fixed points to measure.

So we developed a statistical imaging technique based on MRI scans, which produces a 3-D picture taken from the 'average' of all the footprints. This showed us that the print-maker at Laetoli was pushing off the front of their foot as they walked, indicating an upright gait more like that of modern humans than apes, which push off on the middle of their foot.

It's an exciting advance for palaeontology, but what of the wider applications?

As there's no evidence for another hominid existing four million years ago, our upright walker is probably *Australopithecus afarensis*, which until now was still thought by many to move in a crouched position like an ape.

It's an exciting advance for palaeontology, but what of the wider applications?

The way people's feet exert pressure to make footprints turns out to be almost as characteristic as fingerprints. So, for example, pressure measurements could be used for identity checks as people walk through passport control. We can use exactly the same techniques to assess the probability that a given individual made footprints found at a crime site. And we can apply the same principle to check for the diagnostic features of foot pressure in diseases, for example diabetes, which affects blood circulation in the feet. Farmers could even use our approach to automatically alert them to foot rot in individual sheep or cattle as they walk through a gate or into a barn.

The team is already working with a commercial company to develop the security application, and training workshops for the forensic approaches are planned for the next two years. Clinical applications will need several years of testing before they can be adopted by the NHS, but could be available in UK hospitals before the end of the decade. ■