Artificial intelligence joins the fossil hunt

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THE traditional image of the fossil-hunting palaeontologist - traipsing across parched badlands armed with nothing but hand tools and a sharp eye - may be in for an overhaul. Artificially intelligent software that scans satellite images of potential dig sites could greatly increase the number of fossils unearthed.

Success in finding bones boils down to a lot of luck, says Robert Anemone of Western Michigan University in Kalamazoo, who once blundered into "the best locality we ever found" - a cache of early primate bones from between 40 and 50 million years ago - after making a wrong turn during a trip in the Great Divide basin of south-western Wyoming.

He and Glenn Conroy, a palaeoanthropologist at Washington University in St Louis, Missouri, wanted to improve the odds of success. "We thought 'there's got to be a better way'," Anemone says. "We started talking about making a predictive model of where one might find fossils."

Their model uses computer learning systems called neural networks to spot promising fossil sites from satellite data.

Such software must first be taught what to look for. So the team began by feeding the software a list of known locations in the 10,000-square-kilometre Great Divide basin, labelling them either as being fossil-rich or belonging to one of four other categories - barren, forest, scrub or wetland. Rather than telling the system what to look for to identify each type of location, they had it analyse six bands of visible and infrared light recorded by the Landsat 7 satellite and come up with its own identifying marks.

Next the software sorted unknown areas of the basin into the five categories. On the first pass the computer found "a huge portion of the basin was similar to what we had always found to be productive locations", says team member Jay Emerson, also at Western Michigan University. Using only the satellite data, the computer had learned that the area's fossil sites were in sandstone - but not all sandstone has fossils at the surface.

To distinguish fossil-rich sandstone, the team added two other geological requirements to the software. The rocks had to be 50 million years old, as that is the age of the primates they study, and the land had to be sloped by at least 5 degrees, so erosion was likely to have exposed fossils. They also modified the computer model to account for the 15-metre resolution of the satellite data, which meant that pixels often spanned more than one type of surface.

To assess their software, the team compared model predictions with the characteristics of other known locations they had not fed into the computer. It correctly identified 79 per cent of the known fossil sites as likely to contain fossils, and correctly classified 84 per cent of all the other locations,

Emerson says. Anemone will present the team's work at the Society for Vertebrate Paleontology meeting in Las Vegas, Nevada, this week.

The acid test will come next summer, when Anemone and Conroy plan to visit previously unexplored sites that the model predicts could be rich in fossils. "There are three or four parts of the basin that we will look at; nobody would be likely to go there otherwise," says Anemone. Once on the ground, the pair will again use their trustiest fossil-hunting tool - their eyes. Identifying bones from among rocks in an outcrop is something robots are not yet ready for, Anemone says.

However, Emerson says that high-resolution images from an aircraft flying 1.5 kilometres above the Earth could give 15-centimetre resolution. That's good enough to pick out the most promising spots on a large outcrop, which could save bone-hunters days of trekking as they comb large rock formations.

Palaeontologists already use aerial and satellite images to plan fieldwork. This would be "a more sophisticated way of doing something we've done for a long time", says palaeontologist Peter Dodson of the University of Pennsylvania in Philadelphia, who was not involved in the work. "Anything that helps palaeontologists is all to the good."

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