Paleontologists turning to neural networks to find new dig sites

November 9 2011, by Bob Yirka

(PhysOrg.com) -- For hundreds, if not thousands of years, researchers of one kind or another have dug into the earth in search of clues to help explain our past. In so doing they have found evidence of ancient peoples that roamed around in an environment that we can only vaguely imagine. Such evidence is generally composed of remnants of dwellings, clothing, tools and most especially bones. Traditionally, such relics have been found either by accident or by serious-minded teams of professional scientists scanning likely terrain and having at it with small axes and shovels.

Now however, new technology is helping such teams better their chances. Satellite imagery, for instance can highlight certain types of geographical regions that are similar to others that have been found to contain fossils, thus reducing the amount of ground that paleontologists must cover. But even that can only reduce the work so much. Enter Bob Anemone, a paleontologist and his team from Western Michigan University; they've developed a computer system that can scan satellite images for them and highlight the areas that are most likely to contain fossils, thus increasing the chances of finding fossils while doing far less work. They have published their findings in *Evolutionary Anthropology*.

To create their system, the team turned to neural networking technology, which essentially means creating computer software to mimic how the human brain works. It's all about pattern matching and learning from what has been learned already. To apply neural networking to the science of fossil finding, the team fed the system satellite images which were

analyzed to separate out different light wavelengths corresponding to different types of terrain. Then the system was “taught” to look for certain patterns by showing it places that were already known to contain fossils. After that, images taken of virgin territory were entered into the system and it highlighted areas that matched what it had learned from existing sites. With that information in hand, the team can then head out into the wilds with far more confidence of finding something worthwhile.

So far, the whole idea is mostly theory, though the system did correctly find known fossil sites that it wasn’t told about beforehand 79% of the time in testing. And of those very small areas that it flagged as especially likely, it was right 99% of the time. Interesting in the lab, but the team won’t find out just how well the system really works till they actually travel next summer to a target they’ve picked out, the Great Divide Basin in Wyoming, and start digging.

More information: Finding fossils in new ways: An artificial neural network approach to predicting the location of productive fossil localities, *Evolutionary Anthropology*, Volume 20, Issue 5, pages 169–180, September/October 2011 DOI: 10.1002/evan.20324

Abstract
Chance and serendipity have long played a role in the location of productive fossil localities by vertebrate paleontologists and paleoanthropologists. We offer an alternative approach, informed by methods borrowed from the geographic information sciences and using recent advances in computer science, to more efficiently predict where fossil localities might be found. Our model uses an artificial neural network (ANN) that is trained to recognize the spectral characteristics of known productive localities and other land cover classes, such as forest, wetlands, and scrubland, within a study area based on the analysis of remotely sensed (RS) imagery. Using these spectral signatures, the

model then classifies other pixels throughout the study area. The results of the neural network classification can be examined and further manipulated within a geographic information systems (GIS) software package. While we have developed and tested this model on fossil mammal localities in deposits of Paleocene and Eocene age in the Great Divide Basin of southwestern Wyoming, a similar analytical approach can be easily applied to fossil-bearing sedimentary deposits of any age in any part of the world. We suggest that new analytical tools and methods of the geographic sciences, including remote sensing and geographic information systems, are poised to greatly enrich paleoanthropological investigations, and that these new methods should be embraced by field workers in the search for, and geospatial analysis of, fossil primates and hominins.

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