HELMHOLTZ Matter

NEWS SHEET

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From Matter to Materials and Life

April 2026

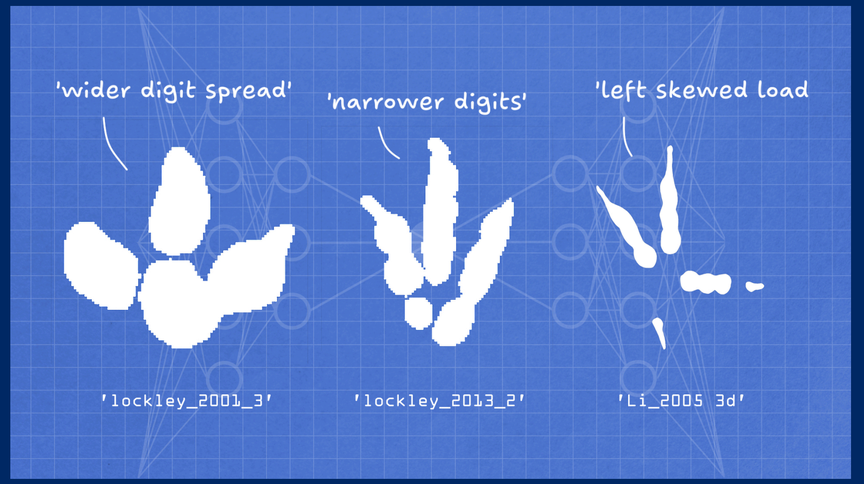
DINOTracker

AI re-analyzes dinosaur footprints

„This study is an exciting contribution to palaeontology. It opens up new possibilities for understanding how these incredible animals lived and moved."

Prof. Stephen L Brusatte, U Edinburgh

Three-toed tracks in focus



For decades, palaeontologists have puzzled over mysterious three-toed dinosaur footprints. Were they made by fierce carnivores, gentle plant-eaters, or even early birds? Now, an international team of physicists and paleontologists has used artificial intelligence to tackle the problem — and developed a free app that allows anyone to help decode the past.

Dinosaur footprints are iconic trace fossils, but interpreting them is notoriously difficult. Traditional machine-learning methods require huge datasets and manual labels, which can introduce bias — especially because the true maker of a footprint is rarely known with certainty. To overcome this, a team led by Gregor Hartmann of Helmholtz-Zentrum Berlin and Stephen Brusatte of the University of Edinburgh used an unsupervised neural network known as a disentangled variational autoencoder.

„Identifying variation in dinosaur footprints and classifying problematic specimens via unbiased unsupervised machine learning"

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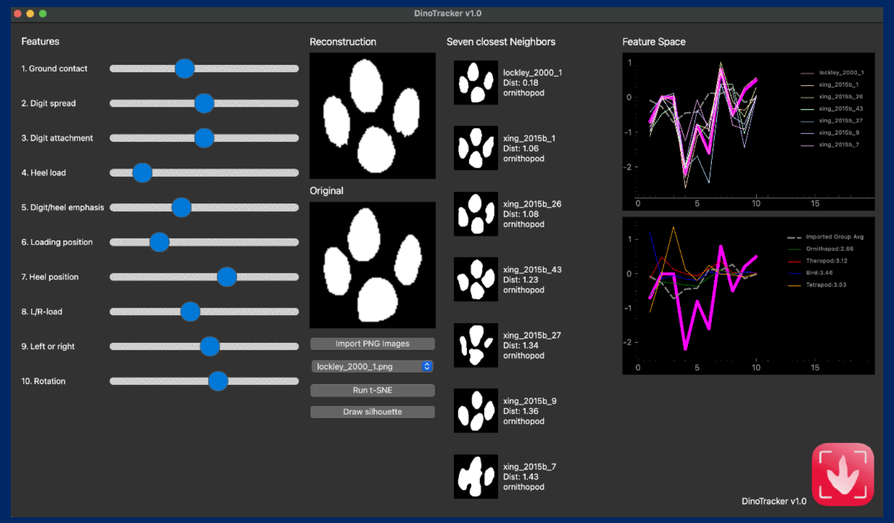
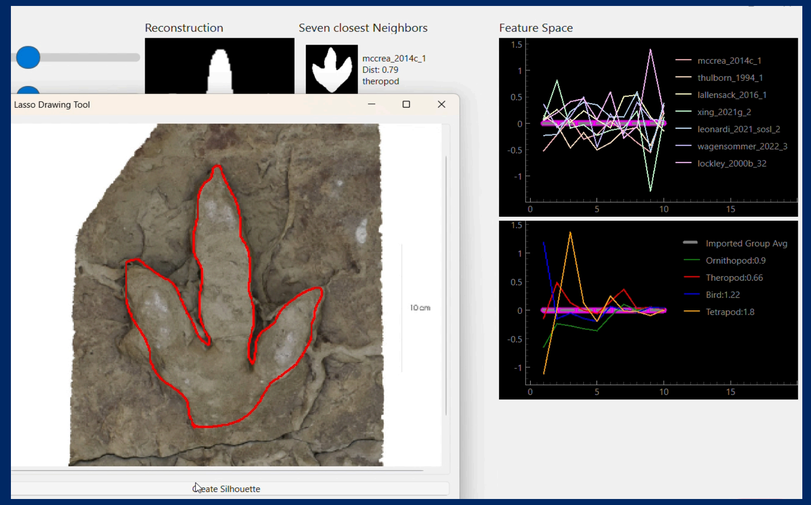
On the trail of dinosaurs

The team trained the model on nearly 2,000 fossil footprints, plus millions of augmented variants simulating realistic changes such as compression and edge displacement. After testing almost 1,000 neural architectures, they identified a compact, robust network that independently detected key factors in footprint variation: amount of ground contact; digit spread; digit attachment; heel load; emphasis on digits and heel; load position; heel position; and left-right loading. Compared with expert classifications, the algorithm reached 80-93% agreement, even for disputed specimens.





Science for all: The DinoTracker app

To make their research accessible, the team developed DinoTracker — a free app that allows scientists and interested members of the public to upload or sketch a footprint and receive an instant analysis. "Our method offers an unbiased way to detect variation in footprints and test hypotheses about their makers," says Hartmann. "it is a tool for research, education, and even fieldwork."

Download DinoTracker-App

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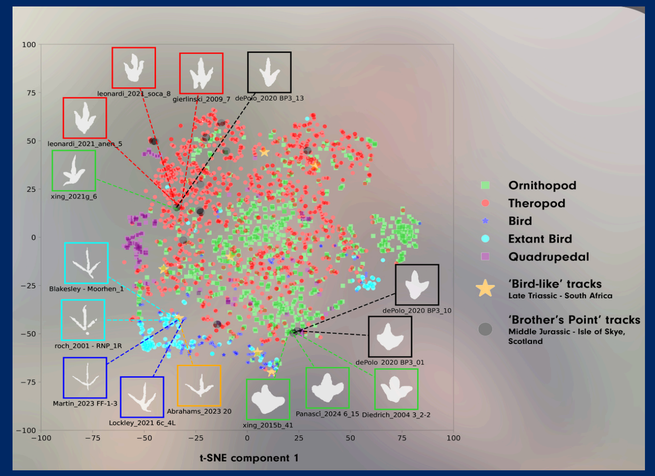
Developed for large-scale research facilities, applied to dinosaur tracks

The AI techniques used here are based on methods originally developed to optimise the large-scale research facilities of Helmholtz Matter more efficiently — for example, to analyse electron trajectories in the BESSY II storage ring in Berlin or to characterise the X-ray pulses of the FLASH free-electron laser in Hamburg. These methods continuously improve how such facilities can be used.

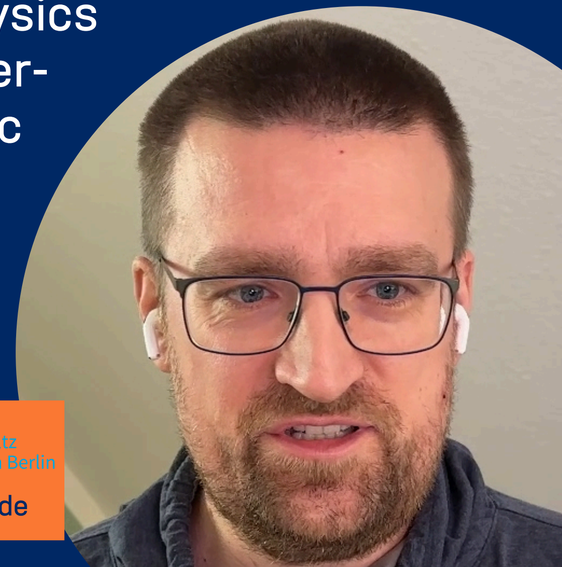
But their potential reaches far beyond that original field: in addition to dinosaur tracks, similar techniques can also be used to examine brain scans for early signs of dementia, identify nuclide contributions in gamma spectra, or evaluate chemical reactions in batteries and catalytic materials.

BESSY FLASH



„It is exciting to see how these tools can advance both cutting-edge physics research and our understanding of prehistoric life."

Dr. Gregor Hartmann, HZB



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Impressum: