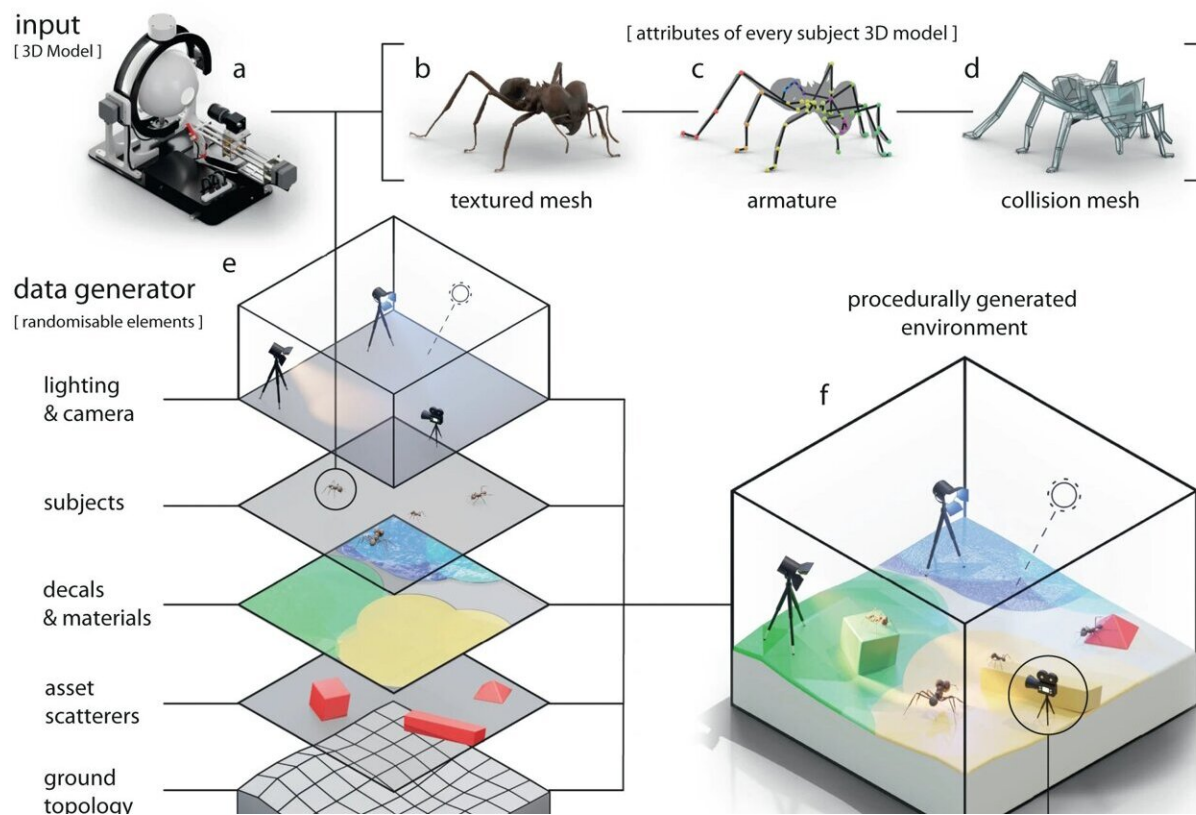# New tool to help AI track animals could boost biology research

November 14 2023, by Caroline Brogan

replicAnt is a toolbox designed to procedurally generate and automatically annotate image samples from 3D animal models. The combination of images and annotations constitutes "synthetic data," which can be used in a wide range of deep learning-based computer vision applications. **a** *replicAnt* requires digital 3D subject models; all but one subject model used in this work were generated with the open-source photogrammetry platform *scAnt*[51]. Each model comprises **b** a textured mesh, **c** an armature defined by virtual bones and joints to provide control over animal pose, and **d** a low-polygonal collision mesh to enable

interaction of the model with objects in its environment. **e** 3D models are placed within environments procedurally generated with a pre-configured yet customizable project in Unreal Engine 5. **f** Every scene consists of the same core elements, configurable via dedicated randomization routines to maximize variability in the generated data. 3D assets are scattered on a ground of varying topology; layered materials, decals, and light sources introduce further sources of variability across scene iterations (see examples in Figs. 2–6). From each scene, we generate **g** image, **h** ID, **i** depth, and normal passes, accompanied by **j** a human-readable data file which contains annotations and key information on image content (see "Methods" for details). Synthetic datasets generated with *replicAnt* can then be parsed to train networks for a wide range of computer vision applications in animal behavioral research, including **k** detection, **l** tracking, **m** 2D and 3D pose-estimation, and **n** semantic segmentation. Credit: *Nature Communications* (2023). DOI: 10.1038/s41467-023-42898-9

Biologists often study large numbers of animals to collect data on collective and individual behavior. New machine learning tools promise to help scientists process the huge amount of data this work generates more quickly while lessening workload.

Now, a new tool called replicAnt simplifies and streamlines the way the training images for these machine-learning tools are created, making it quicker and easier to record observations about lots of animals at once, starting with insects.

Animal database

Existing AI-enabled tools for this purpose require users to painstakingly hand annotate hundreds of frames to provide a database for the computer to learn from. To combat this, replicAnt automatically creates thousands of annotated images with the click of a mouse, seamlessly incorporating variations in species and environments. Ultimately, these

AI-generated data may increase the speed and robustness of using AI tools in [animal research](#).

The work is [published](#) in *Nature Communications*.

Lead author Fabian Plum, Ph.D. researcher at Imperial College London's Department of Bioengineering, said, "It takes a lot of time to set up studies on large numbers of animals and to learn how to use new tools. replicAnt lowers the entry barrier for biologists to use machine learning to optimize their work."

The tool builds on the research team's previous tool, scAnt—a 3D scanner that photographs [small animals](#) in meticulous detail to produce high-resolution 3D models of critters. The 3D models generated by scAnt were used within replicant, which uses the 3D software Unreal Engine to produce training images for detecting and tracking animals in the lab and in nature, freeing up researchers' time and streamlining their work.

To demonstrate the utility of replicAnt, the researchers trained neural networks—sets of algorithms that recognize underlying relationships in data—on these images. This allowed the [neural networks](#) to recognize individuals and track their movements across different environments out-of-the-box. For others, the required hand-labeling of real images was reduced by an order of magnitude.

Fabian said, "Understanding animal behavior, particularly as our climate changes, is crucial. We hope our tool can help to make the time-intensive process of collecting crucial data easier and faster."

Further applications might include using real-time movement data to inform character movement in film and video games.