DEPARTMENT OF COMPUTER SCIENCE

435 – Project ANTS

AI-Driven Automated Joint Recognition and Rigging of Digitized Ant Specimens via Computer Vision

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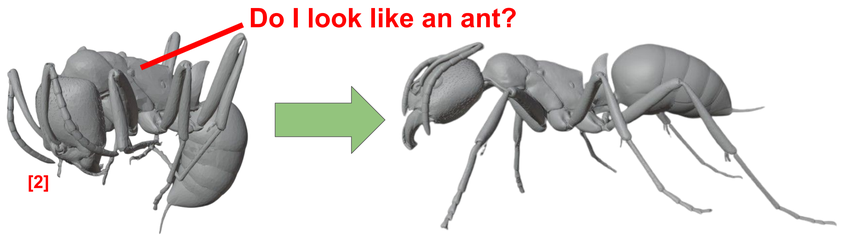
The Objective

Advancements in Micro-CT scanning tech have allowed entomologists to **digitize thousands of specimens** in high detail. **Ant specimens are often scanned in unnatural, crumpled poses**, due to their storage making them hard to study or animate.[1] Manually rigging and animating a single 3D ant model can take *months.* Researchers need a faster, scalable means of preparing these 3D models for analysis and reuse.

Our goal is to automate the rigging process.



The Impact

A collection of these pre-rigged ant models has huge potential for **research** and **commercial applications.** Beyond use in entomological and biological research, this data opens the door to nature-inspired robotics and **reinforcement learning applications.**

Making these models publicly available would also allow for their use in new art, 3D modeling, video games, and even animation. This would also bring real biodiversity to digital environments like VR and AR spaces.[1]

Entomology Research

ML / RL / Robotics

Art & Video Games

Virtual / Augmented Reality

Our AI Solution

Automated model rigging requires knowledge of the ant's joint locations. In order to automatically identify these points, **we have custom-trained a machine learning model** using state of the art computer vision techniques.

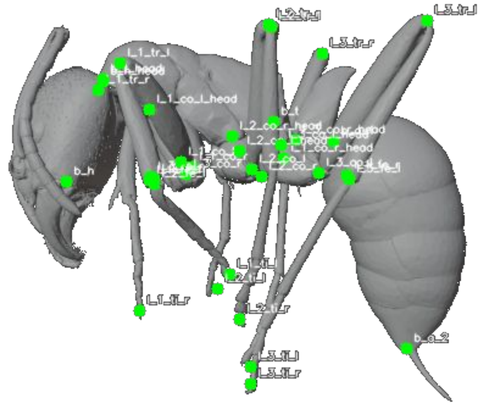
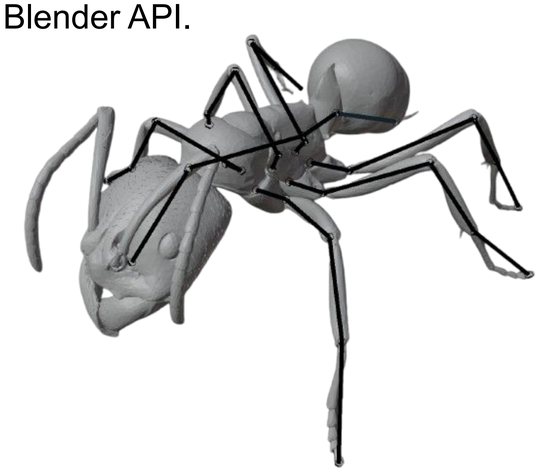


Figure A (above): A side-view of an ant model with joint labels produced by our pose estimation model

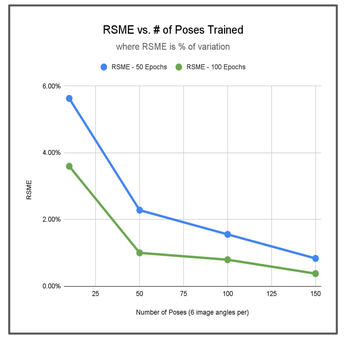
Training a pose estimation model requires a large set of labeled training data – larger than we would be able to hand label ourselves. To circumvent this problem we turned to **synthetic data generation**, inspired by tools like **replicAnt**[8].

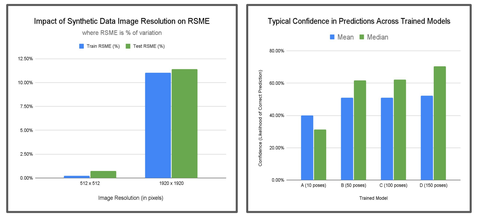
Hand-rigging ant models (see: Figure B) with a pre-labeled armature allowed us to **generate large amounts of synthetic data.** A single rigged ant can produce hundreds of randomized poses through scripting with the Blender API.

Figure B (right): A hand-rigged ant model displaying its armature. Such models can be posed through scripting to simulate the initial 'crumpled' position of scanned specimens



Results





We have successfully trained a pose estimation model using **DeepLabCut**[6]**,** which predicts the location of joints for a given 3D ant model. End to end, our system can intake a previously unseen 3D model, and output a **fully articulable, rigged ant.**

Conclusion

The system we have developed can be used to **automatically rig ant models at scale,** allowing researchers to fully leverage advancements in Micro-CT technology and the growing repository of digitized ant models.

Our methodology for pose estimation and synthetic data generation is **not ant-specific** and can be applied to domains **beyond entomology.**

Citations

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