

InvertNet: A New Paradigm for Digitization of Invertebrate Collections

Imaging Hardware for larger specimens

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Scope

- 22 institutions
- 56 million specimens

InvertNet Goals

- Digitize all holdings of 22 arthropod collections (>50 million specimens)
 - Specimen images and metadata (label info)
 - Drawers, vials, slides
 - Advanced imaging (including 3D)
 - Best quality at <u>reasonable cost (~</u>\$0.10/specimen) and <u>reasonable</u> <u>time investment</u>
- Provide access to images and other data via online virtual museum
 - browsable/searchable/zoomable web interface
 - link to other data providers (GBIF, national ADBC HUB, etc.)
- Provide platform for research and development of additional tools and resources
 - Data mining and analysis
 - Community building, collaboration, and support
 - Education, outreach, and reference



InvertNet Goals





- Digitization workflows
- Network architecture/data management

Image capturing technology



InvertNet Goals

Image capturing technology





NC STATE UNIVERSITY | 125 YEARS

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Insect Museum

home | donate | blog | people | research | calendar | history | specimens | policies | public

Welcome

Housed in the Department of Entomology and the College of Agriculture and Life Science, the NCSU Insect Museum is dedicated to the acquisition and preservation of resources in systematic entomology useful to the NCSU Department of Entomology, the citizens of North Carolina, and the broader systematics community. We also host the Treehoppers website (Deitz and Wallace) and the Hexapod Haiku Challenge, which happens every March.



Search our specimens at the NCSU Insect Museum specimen database portal. Explore and annotate our virtual collection at GigaPan.org!



Digitization Workflows: Drawers

- tested 3 alternative systems for automated capture of high-res images of drawers
 - GigaPan robot
 - CNC machine
 - Parallel robot
- preferred system includes following hardware:
 - custom assembled robot with aluminum frame and 4 pairs of carbon fiber arms controlled by precision stepper motors
 - high-res industrial camera
 - telecentric len
 - LED lighting array
- software detects edges of drawer and moves camera over a grid capturing multiple images of drawer





GigaPan



CNC machine



parallel robot

Maintaining Consistent Feature Size





Advancing Digitization of Biological Collections









Imaging Setup

- Custom designed precision robotics system
- Precision machine hardware ("over the counter") and machine control software
- High-res industrial camera with low-distortion telecentric lens (1.2X, 120mm working distance, 3 MP)
- 24"x 24" work platform
- State of the art computer vision system (OpenCV)
- Easy to use automated
- Raw images stitched together to produce single very high resolution 2-D image









Results



 3 – 5 minutes per tray (size and speed are programmable)



One stitched PNG image

Results

vick Co., NC ne 1990 Page, et al.



Results







Hardware Cost

Issues

High end cameras/robots and lighting are prohibitive





A revolutionary patented technology to capture large area objects





Read a review of SatScan® - Collections by the Natural History Museum London

High Resolution SatScan® - Collection Images

Apoidea (Bees) Aves eggs Diptera (Flies) armeliales (Lichen) ecophoridae (Moths)

Mytilidae (Mussel) Asteroidea (StarFish) Lepidoptera (Butterflies) Coleoptera (Small Beetles) C. Cupreomarginata (Beetles)

C. Lucanidae (Stag Beetles) Ursus Spelaeus (Bear Claw) Hymenoptera (Wasps)

View the SatScan® - Collections brochure



SatScan® - Collections:- Integrated technology provides shadowless sample illumination and precision motion control to generating a 19000 x 15000 (1000 dpi) smoothly glide a high resolution digital camera over the sample area building up stunning and completely in focus digital images



SatScan® - Collections in action

pixel resolution image of an

oecophoridae trav



SatScan® - Collections creates images with no parallax issues therefore all samples are perfectly imaged with no occlusion from sample boxes. All SatScan® images are created with uniform scale therefore measurements are valid anywhere throughout the image.

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Hardware Cost

- Total cost of hardware and software (including computer) is around \$5000
- Interface will be very user friendly
- Software needs to be pre-loaded by us





Stitched images post-processing





- capture image of drawer + metadata (location, contents)
- 2. segment unit trays (image analysis software)
- 3. segment specimens
- 4. capture label data



The Future

- continue to refine and further automate digitization workflows
- Incorporate pan tilt head on camera to allow for 3D reconstruction



Website – please visit

- InvertNet.org
- registration is open to all and available now





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