InvertNet Digitization R&D

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Introduction

- Intro
- Goals
- Technical considerations
- What's been done
- What's next

Invertnet Goals

1. implement ***inexpensive*** toolkit for rapid digital imaging of arthropod collections
    1. $0.10/specimen
2. capture ***high-quality*** digital images of all arthropod collection holdings from 22 midwestern institutions
    1. 55 million specimens
3. Capture ***label data***
    1. Occluded, stacked, handwritten
    2. Oblique imaging
4. ***Support 3D*** reconstructions
5. ***Automate*** – Fast, easy repeatable

Initial Investigations

- GigaPan
  - Inexpensive, slow, camera/integration issues
- Laser
  - 3D, Expensive, fast?, good surface, poor images
- Optical – Structured light and TOF cameras
  - Difficult, $$$
- Commercial Solutions
  - Unpopular, costly, inflexible

This is easy right?

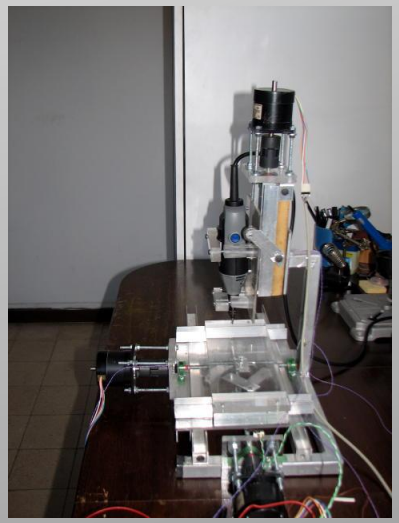
- Move a camera around precisely
- Take some images
- Add image processing software

- Let's put a camera on a CNC and add software!
  - All the parts are available
  - Industrial machines, software, inexpensive computers
- Just pick a machine, camera, bundle software
  - Package and ship
- Easy right?

CNC Machines

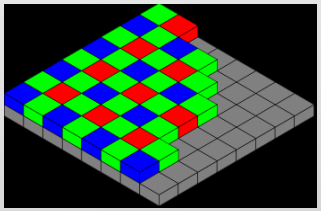
- Accurate
- Inexpensive and widely available
- Programmable

- Size matters?
  - Cost jumps above 12”x12”
  - Big and heavy
- DIY Kits



Imaging Considerations

- Reliability
  - Moving parts
- Integration
  - software and workflow integration – programmable
- Sensors
  - Bayer vs. DCC
    - Data loss, demosaicing errors
- Lens
  - Focus depth, distortion
- Lighting



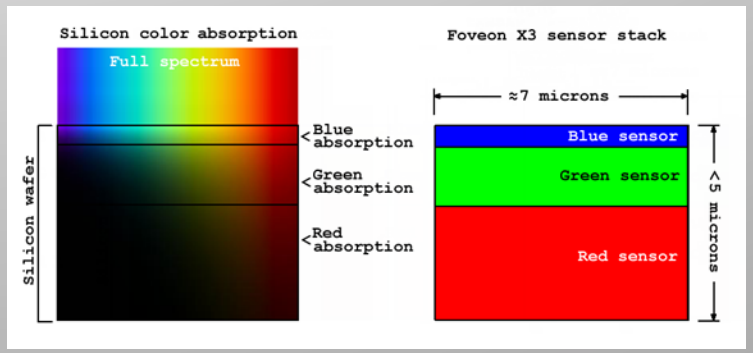
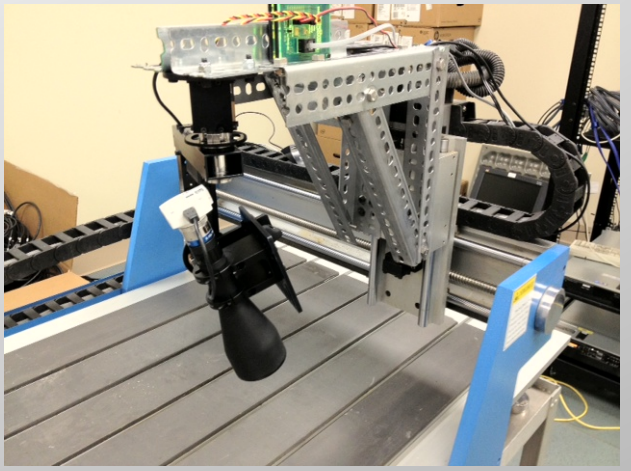


Image Processing Software

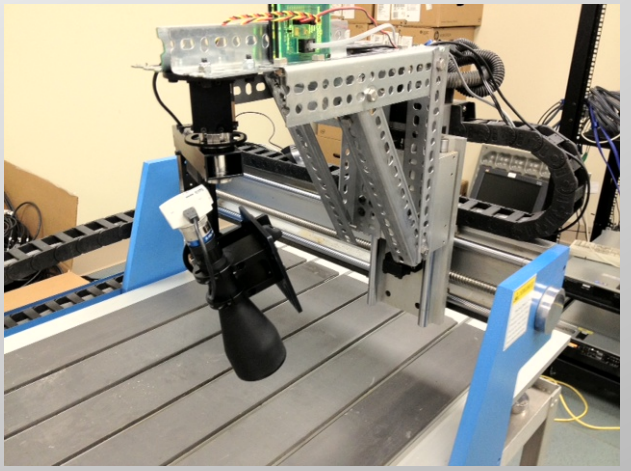
- Stitching
  - Gigapan
  - Hugin
  - OpenCV
- 3D
  - Reference algorithm
- Machine control
  - Input tray dimensions, image grid size, pans/tilts
  - Press go, collect the images.

Testbed Hardware



- Industrial 3 axis CNC machine
  - 24x36 bed for machining signs
- Industrial vision camera
  - Sensor with a USB port
- Telecentric lens
  - No perspective distortion
- Servo controlled pan-tilt
- Home made adjustable mount
  - Test harness before machining proper mount.

First Experiences



- Machine runs programs
  - Few quirks
- Camera works
  - Needs engineering input on quality
- Integration issues
  - VS03 .net – machine program
  - VS08 cam
- Mount needs adjustment
  - 65mm standoff from spec incorrect?

Lessons

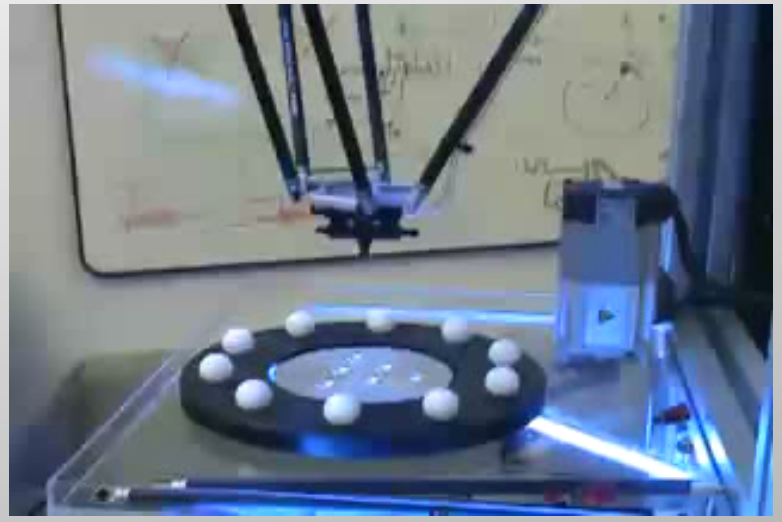
- Machine
  - Find a forklift and a sturdy table – not mobile
- Vendor issues
  - Development support
  - Tech support
  - Motivation
- Lighting
  - Machine is large and moving

Next Steps

- Use more cameras/lenses
- Capture, capture, capture
  - To analyze stitching, 3D and label positions
  - Focus stacks, pan-tilts, resolutions
- Design/machine mounting block
- Integrate with web workflow
  - Error handling in capture, stitch, upload issues
  - Corrections, additions, etc. to previous captures
- Field test

Next: Parallel Robot

- Simpler
  - fewer moving parts
  - Less expensive
- Faster
  - less mass to move
- More manageable
  - Parts fit in small box, shippable, movable
- Less lighting interference



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