Faster, Cheaper, Safer

Autonomous Inspections Are The Future

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Program Name:

Pier Structure from Motion
Utilizing Unmanned Aerial Systems

What makes this project important?

- Piers are areas of extreme traffic
  - Commercial and Recreational
- Damage can be hard to locate
- Inspectors are at risk of possible injury
  - 120 Fatal accidents at pier and bridge worksites every year

- What do piers effect?
  - Shipping and receiving
  - Beach safety
  - Commercial businesses
  - Industrial businesses (seafood)
  - Oceanic travel

Why UAS?

Drones vs Humans:

Faster: Aerial mobility allows for faster inspection.

Cheaper: Allows for a team of 6 to be reduced to a team of 2

Safer: Current pier inspections involve sometimes dangerous expeditions via. Kayak

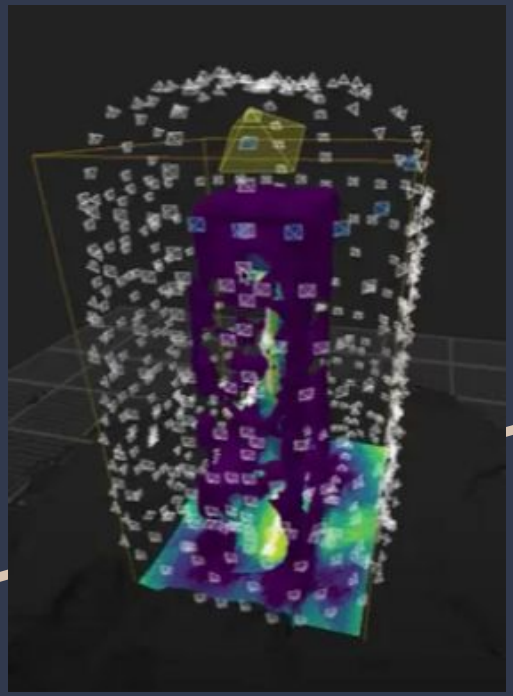
Why hasn't it been done already:

- Drones have trouble navigating over large bodies of water
- Most Drones Rely on GPS navigation
- 3D model needs geolocated photos

What makes it practical:

- Autonomous, less money, faster work, less danger

What we aim to accomplish!



Goal for the project:

- Create 3D models of pier structures using drone imaging for inspections

Goal for us this summer:

- Decide a drone for the data capture
- Experiment with photogrammetry software
- Look into the possibility of computer vision as an aid

How did we benefit the overall project:

- Outlined steps for image processing
- Identified viable algorithms for image classification

Design Requirements & Constraints

Requirements:

- Photogrammetry Software
  - Pix4D
  - Bentley Context-Capture
- Complete coverage without the use of GPS geolocation
- Software that analyzes defects in large data sets
  - Past algorithms
  - Computer Vision

Constraints:

- Increasing quality = Increasing time
- Quality of image reflected in 3D model
- Number of images
- Quality vs Time to process and analyze
- Resolution directly effects inspection ability
- False positives

Attempt	Advantages	Disadvantages
Photogrammetry	- Widely adaptable - Pre-existing applications (Pix4D, Bentley CC, Drone2Map) - Easy to detect thermal differences	- Meshes are not detailed - Takes long to process especially with large data sets - Hard to detect defects with 3D mesh
Computer Vision	- Detect detailed defects - Only need to train once	- Training datasets need to expand a large number of items - Training takes long - “Less” developed for users

Our Proposed Solution

Objective:

- Identify necessary hardware and software for SFM
- Look into fault detection using computer vision

Solution:

- Drone that doesn't need GPS
  - Skydio X2D
    - Skydio 3D (Map Software)
- Photogrammetry Software
  - Pix4D
- Computer Vision Algorithms
  - Using CNN, Tensorflow

Results

What we have accomplished:

- Generated 3D models of NAVFAC facilities
- Identified Skydio UAS as a solution
- Established photogrammetry processing workflow

What We Have Learned:

- Photo location and angles matter
- Geolocation vs Manual Control Points (MCP)
- Computer Vision can act as a filter to screen for defects before we create a model

What is next for this project:

- Testing multiple types of GPS denied environments
- Run tests using Skydio X2D
- See if we could include ROV data to get a complete model of a Pier
- Implement computer vision algorithms to detect defects

Questions?