Using Digital Twins for Drone Swarm Data Aggregation, Presentation, Mission Planning and Control

VARLAB

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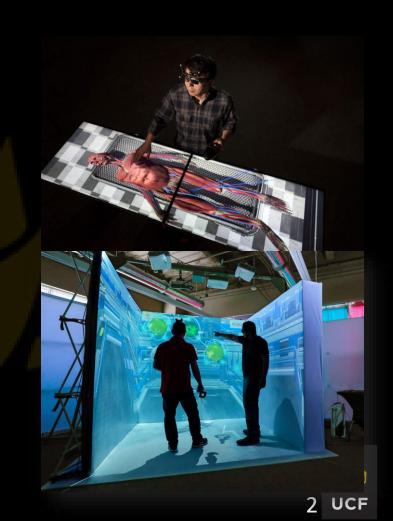dirk.reiners@ucf.edu

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Background

- VARLAB team has 20+ years of experience in Visualization and VR/AR application development
  - Wide variety of topics, systems & partners
- Goal: improve understanding of large and/or complex data through visual analytics and visualizations
  - Immersive, desktop and mobile
- Funded through NSF, Air Force, Navy, National Guard, DHS and others

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Motivation

- Drones are one of the most disruptive battlefield innovations

- Many different sizes and purposes
  - Typically only a few per mission

- Smaller, lighter, cheaper now
  - Limited sensor capabilities, usually just video
  - Tens or hundreds easily carryable, allows swarms

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Drone Swarm Challenges

- Two major challenges

- Information / Integration Overload
  - Interpreting tens or hundreds of moving video feeds almost impossible
  - Especially while commanding an op

- Piloting / control challenge
  - Drones usually still need a pilot
  - Not an option for tens or hundreds

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Goal: Integrated, Live Digital Twin

- 3D Model that integrates all video streams
  - Live project drone videos onto model
  - Record last color
  - Scales to arbitrary number of video feeds
- Regular 3D model, can be used in many different ways
  - Commander: Large screens, tables
  - Operator in the field: Tablet, VR/AR headset
  - Integrate into C&C system, show planned and live force information

Approved for Public Release

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Only Need: 3D Base Model

- Different Choices
    - LIDAR Scan
    - Photogrammetry
    - Worst case: Bing Maps or Google Earth
- Often created already, as part of mission preparation
- Need unique texture usage
    - Usually done by reconstruction tool
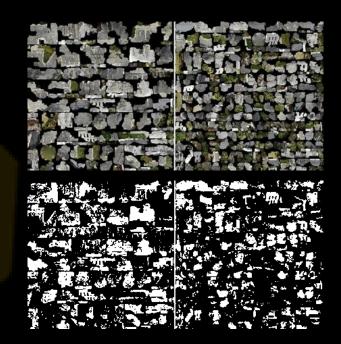   - Can be done automatically

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Automated Drone Control

- Even with lots of drones, the whole model is not always visible

- Goal: Minimize the time between updates

- Solution: Track last update time
  - Additional texture

- Send drone to position to update oldest part
  - Scales to arbitrary number of drones
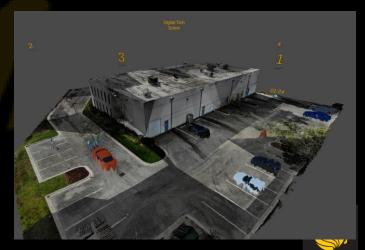 - Lots of variations/optimizations possible

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Status and Future Work

- Built proof of concept with virtual drones
  - Flying real drones hard to do at University
  - Real-time visualization of update time
  - Automatic control

- Optimize drone control efficiency
- Integrate 3D reconstruction
  - Needs to be realtime & incremental
- Use for other applications
  - E.g. site security with fixed cameras
- Use with actual drones

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Thank you for your time!

See me for a live dem

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