The work depicted here was sponsored by the U.S. Army. Statements and opinions expressed do not necessarily reflect the position or the policy of the United States Government, and no official endorsement should be inferred.
OWT Overview

- US Army funded R&D effort with support from J7
  - Ongoing since 2013
- Objective: create a 3D polygonal representation of the planet down to <1m resolution – aka Google Earth
  - Usable in M&S, rehearsal, visualization and analysis tools
- Part of Army’s Synthetic Training Environment (STE)
  - Next-generation game/virtual platform
Why?

Cost
- The Army has spent >>$1B on generating terrain databases for various games, sims and training systems

Time
- On average, it still takes 13 months to manually create the average terrain dataset for M&S (1km x 1km)

Reuse
- There are >100 different versions of the same databases (e.g. McKenna MOUT), many build once, used and thrown away

Quality
- The fidelity & correctness of the databases are nowhere close to rendering /simulation capabilities available today
1. **Engineering** – building, storing and serving a global 3D repo of <1m geo-specific terrain

2. **R&D** – rapid procedural creation of geo-specific simulation terrain using autonomous systems (drone collection)

3. **Governance** – collaborations with govt (NGA, AGC, NRO) and industry (USGIF, OGC, DigitalGlobe)
Collaborators

- National Simulation Center (NSC)
- Army Geospatial Center (AGC)
- Army Research Lab (ARL)
- PEO STRI
Government vs. Industry

- GIS community consensus: by 2025 a large % of the land surface will be ‘mapped’ to cm-level resolution
- Most data, if not all, will be available on the open market
  - Including to our enemies
- How does T&E evolve to exploit this new data, and stay ahead of our opponents?
Future Terrain Challenges

- Our advantages of collection are eroding
  - Social media
  - Crowd-sourcing
  - Ubiquity of collection platforms - drones, phones
  - Commercial purchase of aerial / satellite imagery
- How do we stay ahead?
Maintaining Terrain Overmatch

- Exploit new sources of collection
- Process collected data in a way unavailable to our enemies
- Turn ourselves into a mass collection store (i.e. Google Earth for Government)
**Primary OWT Focus Areas**

- **Collection**
  - How is terrain data collected in the future?
  - What form does it take?
  - Who has access to it?

- **Creation**
  - Creating data usable for M&S
  - Both automated and manual processes

- **Storage**
  - How to store the data
  - Make it secure but accessible

- **Distribution**
  - How to provide large amounts of data over the network

- **Application**
  - How does simulation exploit new types of geospatial data
**OWT Focus is *Data*, not Tools or Standards**

<table>
<thead>
<tr>
<th>Data Type</th>
<th>Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>Elevation</td>
<td>NASA SRTM v3 – 1 arc second (30m)</td>
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<tr>
<td>Vegetation</td>
<td>NDVI (250 – 500m)</td>
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<tr>
<td>Imagery</td>
<td>WorldView 4 (30cm)</td>
</tr>
<tr>
<td><strong>Buildings &amp; Surface Features</strong></td>
<td>Manual, Procedural, Geo-typical</td>
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<tr>
<td>Roads</td>
<td>Open Street Maps (&lt;1m)</td>
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<tr>
<td>Cultural</td>
<td>Census, Social Media (GPS)</td>
</tr>
<tr>
<td>Water</td>
<td>Bathymetry (500m)</td>
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<tr>
<td>Atmosphere</td>
<td>NOAA, Met services (1 – 100km)</td>
</tr>
</tbody>
</table>
Drone-to-Simulation Pipeline

- Objective: give small-units an organic capability to train and visualize on real digital terrain
- Autonomously fly COTS drones and produce 3D models automatically
- Areas flown:
  - National Training Center (Wasl, Tiefort)
  - Camp Pendleton (IIT)
  - Twentynine Palms (Range 400, 410)
  - China Lake (AUG 2016)
  - USC campus
  - St. Louis Downtown
  - Los Angeles
Section 333 Exemption

- Granted in NOV 2015
- Allows us to fly and collect data legally
- Requirements
  - Must fly approved aircraft (Phantom, S900)
  - Have licensed pilot ‘at the helm’
  - File NOTAM with ATC
Overview

Autonomous Image Acquisition → Automatic Reconstruction → Real-Time 3D Simulation, Analysis, Mission Rehearsal
Details

- DJI Phantom 3 Advanced
- USC-ICT developed app for autonomous flight and image capture
- Pix4d photogrammetry software

Summary

<table>
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<tr>
<td>Average Ground Sampling Distance (GSD)</td>
<td>7.87 cm / 3.1 in</td>
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<tr>
<td>Area Covered</td>
<td>2.37 km² / 237.004 ha / 0.9156 sq. mi / 585.953 acres</td>
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<tr>
<td>Time for Initial Processing (without report)</td>
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