Overview
Automatic, simple 3D mesh models from satellite images
- Build an existing commercial point cloud generation software (Raytheon Intersect Dimension)
- Segment scene into buildings, bridges, and terrain
- Model buildings/bridges with geometric primitives
- Regularized planar roof sections
- Cylindrical and spherical roofs
- Texture map using multiple satellite images
- Deploy on AWS with web-based application for easy use
- Release open source software

Preprocessing
- Render a Digital Surface Model (DSM)
- Pan-sharpen and orthorectify images to DSM
- Normalized Difference Vegetation Index (NDVI) from ortho images to help remove trees
- Estimate Digital Terrain Model (DTM) with cloth simulation filter (Zhang et al. [2])
- Normalized DSM (nDSM) to factor out terrain

Semantics & Shape Fitting
- Semantic segmentation from MS1, nDSM, & NDVI inputs
  - Two-class (building / background) first, e.g. DSM roads to separate building / bridge
  - Simple thresholding (NDVI > 0.1 and nDSM > 2m) as morphology as a baseline
  - Compared three deep networks (GoogLeNet [7], DenseNet [5]-[6], PSPNet [6])
  - Use segmentation to classify building/bridge points from point cloud
  - Classify points as flat, sloped, cylindrical, or spherical with PointNet++ [4]
  - Augment limited curated training samples by “bending” planar samples
  - Fit roof segments per shape category
  - Hierarchical roof topology tree [4] applied to planar segments

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Software
- Software named Danesfield in honor of the WWII center for 3D aerial photographic intelligence
- Algorithms in Python with some C++
- Environment configured with Conda or Docker
- Web Application
  - 3D model and map-based visualization
  - Data and job management
  - Deployed on Amazon Web Services
- Open source: Apache License Ver 2.0

Acknowledgements
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https://github.com/Kitware/Danesfield-App

Urban Semantic 3D Reconstruction from Multiview Satellite Imagery

Matthew J. Leotta, Chengjiang Long, Bastien Jacquet, Matthieu Zins, Dan Lipsa
Jie Shan, Bo Xu, Zhixin Li
Xu Zhang, Shih-Fu Chang
Matthew Purri, Jia Xue, Kristin Dana

Results
- Evaluated on the CORE3D public data and metrics
- Grodels on 2 AOs (UCSD and JAX)

<table>
<thead>
<tr>
<th>Method</th>
<th>UCSD</th>
<th>JAX</th>
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<tbody>
<tr>
<td>X</td>
<td>Y</td>
<td>Z</td>
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