Apr 4th, 3:45 PM - 4:00 PM

Structure from motion on Salish shores: remote mapping for restoration

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Structure from Motion on Salish Shores: Remote Mapping for Restoration

Branden Rishel
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Beaches in the Region: Why Care?

- No coral, not much sediment from rivers
- Feeder bluffs supply ~90% Salish Sea beach seds
- Natural gravel required for forage fish spawning
  - Surf smelt, sand lance, herring
  - Messed up by bulkheads, seawalls, etc.
- Forage fish a keystone species; food for salmon
  - Also food for seabirds and marine mammals
Path to Acceptance of SfM

- Limited R&D in a seven-person company
- Kites, camera-on-a-stick, ground photos
- Initial efforts quick and dirty
- Long path to billable UAV work
Opportunistic SfM (during other field work)
SfM with Others’ Aerial Photos
Ground Photo SfM

- Not even a stick
- One-point ground control with laser rangefinder/inclinometer offsets
- Still useful!
Why Structure from Motion? When?

Structure from motion is a cutting-edge 3D imaging tool that other folks are successfully using to study geomorphology. It’s accessible, quick, and gives results that fill a gap between other techniques. It won’t replace any other technique, just like a handheld Trimble GPS doesn’t replace a total station.

<table>
<thead>
<tr>
<th></th>
<th>Total Station Survey</th>
<th>Structure from Motion</th>
<th>LiDAR</th>
</tr>
</thead>
<tbody>
<tr>
<td>Resolution</td>
<td>Very low</td>
<td>Highest</td>
<td>High</td>
</tr>
<tr>
<td>Precision</td>
<td>Very high</td>
<td>Varies a lot</td>
<td>High</td>
</tr>
<tr>
<td>Color texture map</td>
<td>No</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>CGS can do</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Staff time</td>
<td>High (2 simultaneous)</td>
<td>Moderate</td>
<td>N/A</td>
</tr>
<tr>
<td>Works underwater</td>
<td>Yes, to ~4 feet</td>
<td>No</td>
<td>Not really</td>
</tr>
</tbody>
</table>

Photos can be taken quickly, during currently scheduled site visits. A small site might take 20–30 minutes. A decision can be made later about whether to build a SfM model—the time-consuming part.
SfM Compared to Total Station

- Demonstrated better resolution
- Caught a missed inflection
Armor Encroachment on Tribal Lands

- Larger budget for visualizations
SfM to CAD + 3Ds

- Very good vertical essential
- GCP from licensed surveyors
Armor Encroachment on Tribal Tidelands
Reference Beach
Drone!
Fun mapping for future change

- Future park on fill
- Planned beach restoration
- Future sailing facility?
Eelgrass Mapping

- Good enough for pre-design
Sonar + UAV Surface

- Dredging to nourish
  - Not going to work
- Sonar with water level plus UAV SfM
  - Surface match within ~1-3”
- CAD wizard Adam is busy
Orthomosaics Most Useful?
Lummi Shore Road

- 5.5 miles long, stitched
- 7 field days
- PPK GPS ground control
- Lower target resolution
- During BC fires!
Kite Photos where UAVs Not Permitted

- Cheap
- Tricky
- Requires >10 knots surface wind
- Attitude control not important
Upcoming Work

- Wavelet analysis of surface grain size
- Sediment budgets
- Possible bathymetry
- Immersive visualizations in Unity
- Alpine forest mapping (me but not CGS)
- Automated armor extraction?
Questions?