

UNIVERSITY OF NEW BRUNSWICK FREDERICTON

Aerial Mapping Techniques and Technologies: A Cost Benefit Analysis

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Overview

- Introduction and Scope
- Motivation
- Cost-Benefit Analysis
- Summary
- Acknowledgements



Introduction and Scope

- Digital Elevation Models and Ortho Photographs
- Accuracy Assessment and Cost-Benefit Analysis (CBA)
- Focus on Unmanned Aerial Vehicles (UAVs)

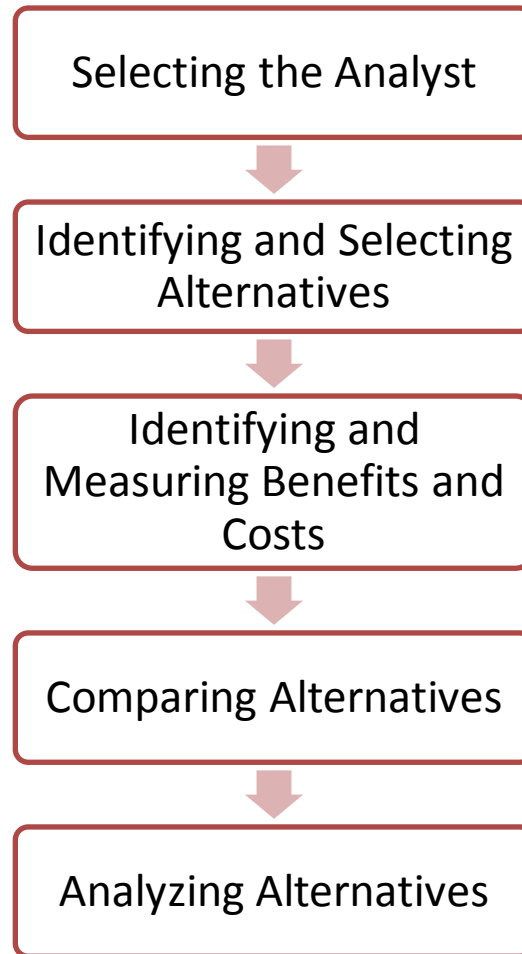


Motivation

- Looking for efficient and cost effective aerial surveys
- UAVs are exciting new technology in the geomatics industry
- Want to see if they are actually a cost effective solution



5 Step CBA Process



Selecting the Analyst

- Extensive Literature Review
- Interviews
- Cases

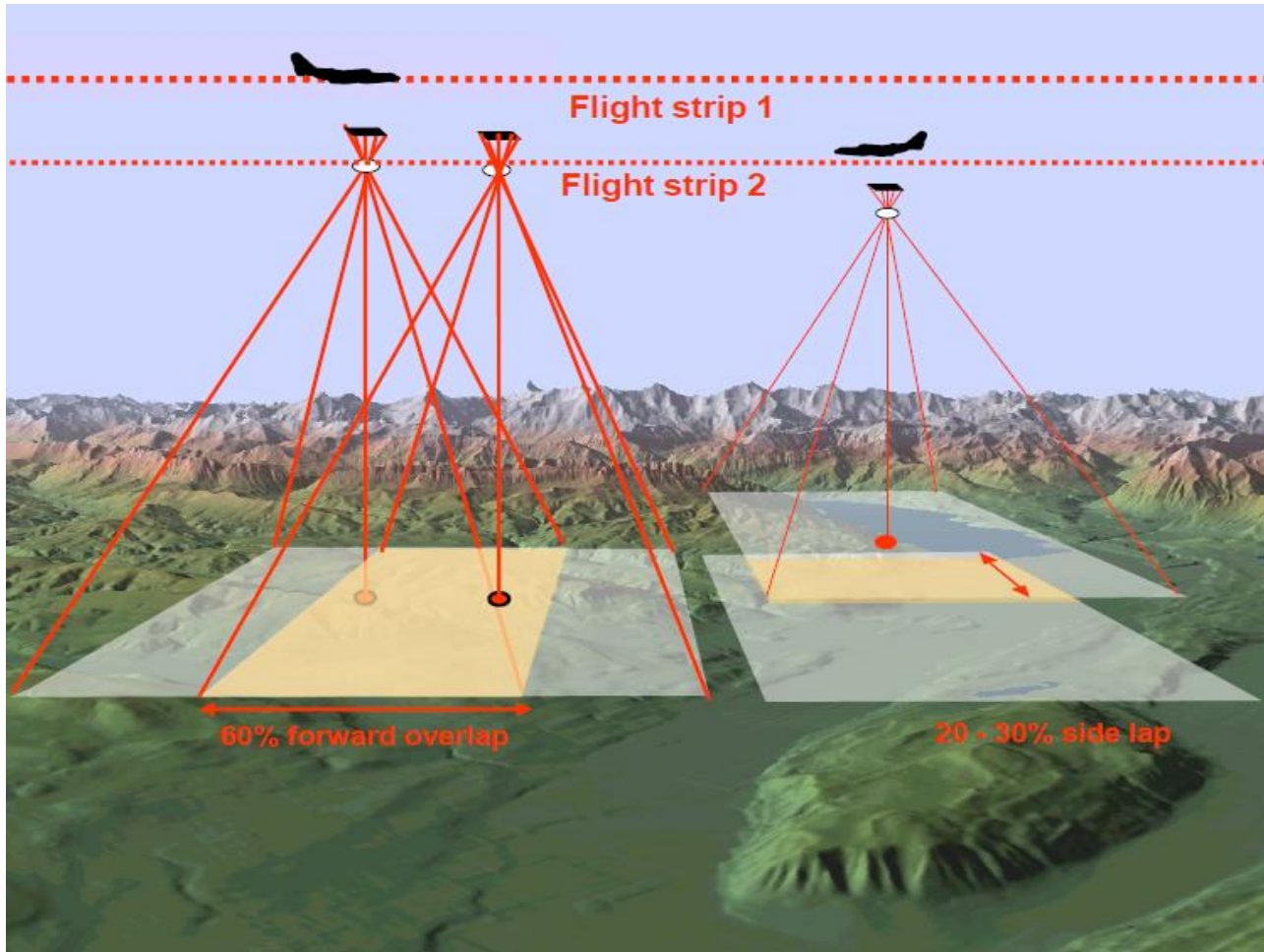


Identifying and Selecting Alternatives

- Photogrammetry
- LiDAR
- UAV
- ...Ground Survey



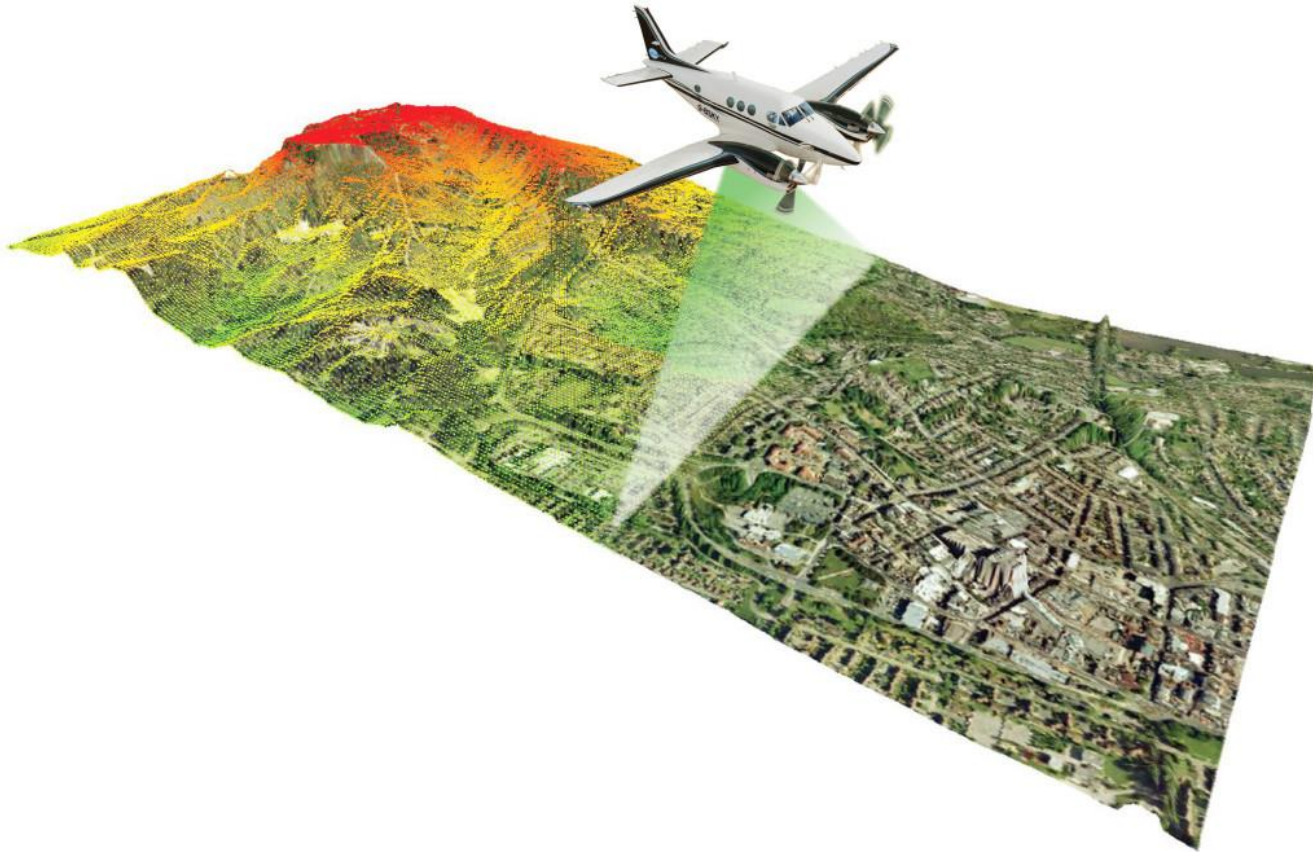
Photogrammetry



Koert Sijmons



LiDAR



Retrieved From: <http://lidar-america.com/?p=1>

UAV

- Trimble UX5



Retrieved from: <http://uas.trimble.com/ux5>

Identifying and Measuring Benefits Photogrammetry and Costs

- Accuracy: $6 \mu\text{m} \times \text{image scale}$
» $0.0006 \times 5000 = 3 \text{ cm}$
- Good for large scale
- New Acquisition: \$12000 - \$15000 for minimum order
- Library: \$1200 - \$1500 for minimum order

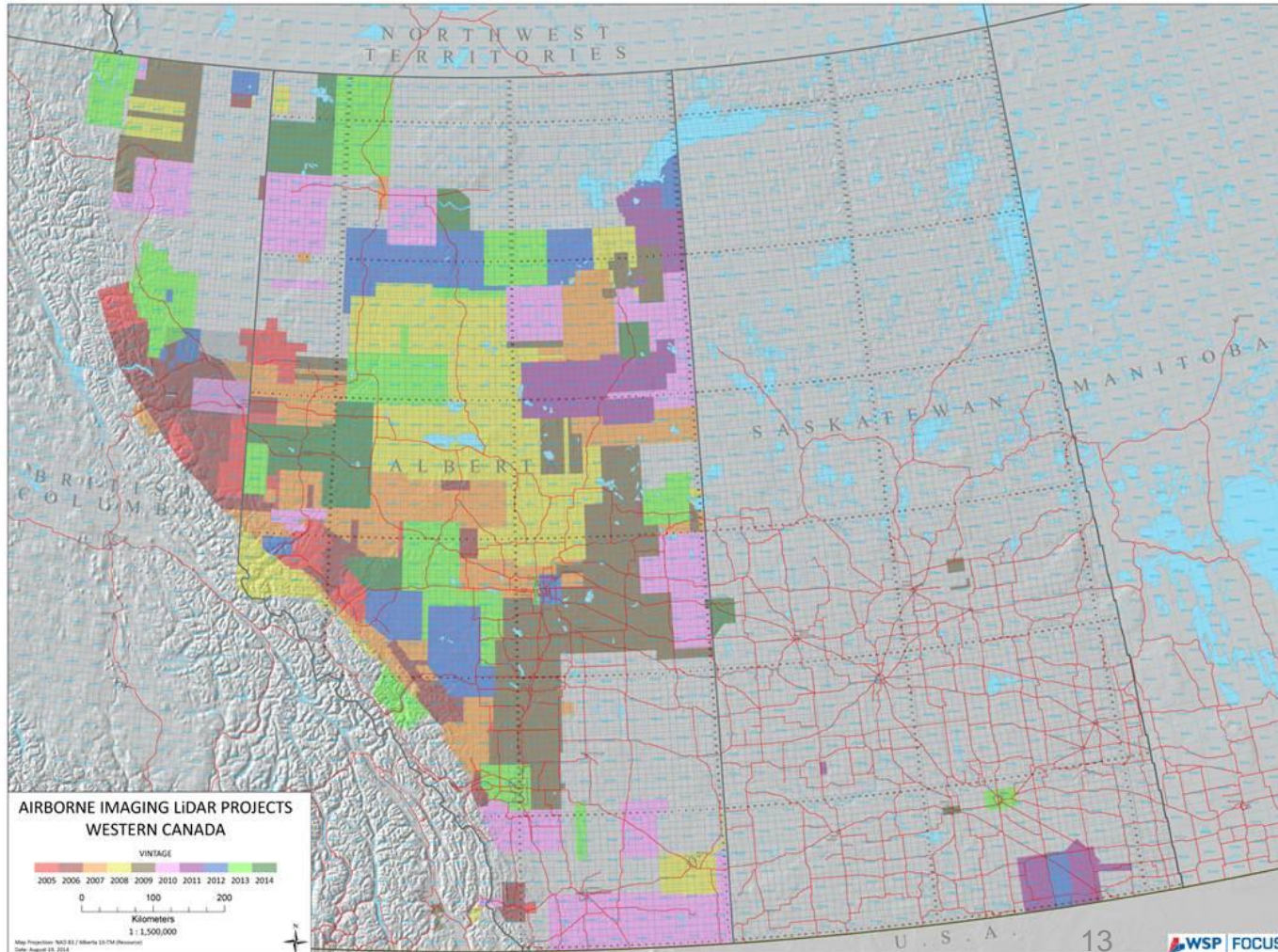


LiDAR

- Accuracy: 15 cm – 30+ cm
- Bare-Earth Model / DSM
- New Acquisition : \$12000 for minimum order
- Library : \$2000 for minimum order (4 km²)
Decreases on logarithmic scale for more



Tarin LiDAR Collection



Trimble UX5 Specifications

Flight Height	75 m – 750 m
GSD (@ 75 m – 750 m)	2.4 cm – 24 cm
Weight	2.5 kg
Wingspan	1 m
Camera	Sony NEX-5R camera (16.1 megapixel) with Voigtlander lens
Wind Speed Capability	65 km / hour
Battery Life (single charge)	50 minutes
Max Coverage (@ 750 m)	21 km ²
Minimum Photo Overlap	60%
Unit Cost	≈ \$40,000



Cosyn & Miller Trimble UX5 White Paper, 2013
Benjamin Sullivan Webinar, 2013

Trimble UX5

	UX5	GNSS
Area	1.5 km ²	1.5 km ²
GCP setup & measurement	1.25 hours	n/a
Setup time	0.25 hours	0.25 hours (per day)
Survey time	0.75 hours	30.5 hours (4 days)
Tear-down Time	0.25 hours	0.25 hours
Data Processing Time	4 hours (2.80 GHz Intel Core i7, 16 GB RAM)	1 hour
Total Time	6 hours	33.5 hours
Ground sample distance	3.8 cm (@ 120 m flight altitude)	15 m
Horizontal Accuracy	2 cm	1 cm
Vertical Accuracy	4 cm	2 cm

Survey Cost Breakdown

Service / Equipment	Hourly Rate (\$ / hour)	UX5 Survey	GNSS
Party Chief	70	2.5	32.5
Survey Assistant	35	2.5	32.5
RTK	25	1.25	32.5
Survey Gear	13	2.5	32.5
Truck	22	2.5	32.5
Office Processing	180	4.0	1.0
UX5	250	1.25	0
	Total =	\$1413.75	\$5542.50



$$8 \times \$1413.75 = \$11310$$

Cost of Various Area Coverage

Area (km ²)	21	15	10	4	3	2	1	0.5	0.2
Number of Pictures	161	240	336	704	990	1408	704	352	144
GSD (cm)	24	16	11.2	4.8	3.2	2.4	2.4	2.4	2.4
Flight Height (m)	750	500	350	150	110	75	75	75	75
Cost (\$)	3500	2700	2050	1380	1370	1420	1000	750	610



Comparing Alternatives

- Photogrammetry: \$1200 - \$15000+
- LiDAR: \$2000 - \$12000+
- UAV: \$600 - \$3500



Analyzing all the Alternatives

Criteria	Recommendation
Accuracy < 5 cm & Area < 8 km ²	UAV
Accuracy < 5 cm & Area > 8 km ²	Photogrammetry
Accuracy Unimportant Area < 42 km ²	UAV
Area > 42 km ²	Photogrammetry
Bare Earth	LiDAR



Summary

- UAV good solution for DEM, Ortho Photographs
- Photogrammetry \$\$
- LiDAR only best for bare-earth



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