

THE NATIONAL CENTER FOR AIRBORNE LASER MAPPING



New Technologies for Data Acquisition and the Need for Tools

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New Technologies



- Point density increased from < 1 pt/m² to 40-80 pts/m²
- Resolution approaching instrument accuracy/spot size

NCALM Higher Repetition Rate UNIVERSITY of Houston



• Oversampling of terrain can occur, limiting resolution even in high density surveys.

Multiple Frequencies



Current NCALM lidar – *Titan MW* 1st of its kind developed for NCALM

NCALM



900 kHz total PRF: Simultaneous data collection Three wavelengths: 532 nm, 1064 nm & 1550 nm PRF: Up to 300 kHz full waveform for each wavelength Operating altitude: 300 – 2500 m DiMAC D-8900: 60 MP Aerial Camera



- Active lidar reflectance from multiple channels shown to dramatically improve data classification
- Can spectral signature be used to enhance change detection beyond 3D point cloud?

NCALM Flexible Instruments



HELICOPTER PLATFORMS



• Flexible and cost effective deployment to remote locations

UAV/MOBILE PLATFORMS





${\rm INCALM}$ Single Photon Sensitive Lidar





$\underset{\mbox{N}}{\hbox{N}}$ N C A L M $\,$ Single Photon Sensitive Lidar $\,$





NCALMSingle Photon Sensitive Systems UNIVERSITY of Houston Berkeley

- Higher flight height = larger areal coverage
 - ~1000 km² an hour at 8 pts/m² versus ~100 km²
- High point density (6 200 MHz raw data rate)
- Require significant filtering and in some cases smoothing
- Noisier datasets (vertical accuracy 10 to 20 cm).
- Noise in the critical zone a significant Issue

$\operatorname{M} N C A L M$ Structure from Motion



- 3D scene generation from multiple overlapping photographs
- Software tools available in both open source and with minimal investment (~\$1000)
- Significant processing time for high resolution models
- Little to no vegetation penetration.
- But, still a 3D point cloud...

N C A L M Need For Tools

- From Early 1990s to ~ 2010, most lidar surveys were the first high resolution model of an area.
- First NSF supported repeat survey for NCALM was in 2010, the El-Mayor Cucapah Earthquake.
- In last 10 years, explosion of repeat surveys.
- Currently >100 peer-reviewed papers discussing temporal differencing of 3D datasets.



Oskin M, Arrowsmith J, Corona A, Elliott A, Fletcher J, Fielding E, et al. Near-Field Deformation from the El Mayor-Cucapah Earthquake Revealed by Differential LIDAR. Science. 2012 FEB 10 2012;335(6069): 702-5.

NCALM Need For Tools



- data density and accuracy is not uniform (e.g. EMC)
- horizontal motion corrupts DDEM
- ICP (iterative closest point) assumes rigid body motion
- PIV (particle imaging velocimetry) requires data gridding is not truly 3D
- Data not processed on same datums
- different collection conditions or acquisition modalities
- quantification of level of significance (error) is missing.
- Need to incorporate underlying process knowledge to inform model

NCALM Need For Tools



- Evaluation and comparison of developed methodologies is mostly lacking in the literature
- Tools in use were not specifically designed for the science questions they are being applied to
- Quantification of uncertainty is practically non-existent
- Non-rigid 3D methods still require development only minor attempts to data in Earth science

NCALM SEED Proposals



ANNUAL NCALM SEED PROPOSALS:

- Up to 40 km² in continental US for a graduate student PI
- Deadline: Annually in mid-December
- Details at: www.ncalm.org
- Proposals examining shallow water bathymetry or change detection using previously flown lidar are encouraged.
- Questions? ncalm@egr.uh.edu or clglennie@uh.edu