Polarization Lidar Bathymetry

Steve Mitchell

ASEN 6519

Department of Aerospace Engineering Sciences University of Colorado at Boulder 4.15.2011



Outline

- Background
- Motivation
- Polarization scatter
- Prototype instrument





BACKGROUND



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Background

- Transmit pulse of laser radiation (1)
- Reflection off target (2)
- Receive return pulse (3)
- Range is function of transit time



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Background

Account for

- Timing, sampling rate
- Beam divergence
- Pulse energy, width, rep rate
- Platform characteristics
- Target characteristics
- ...and many more!



[3]

History

- Satellite, lunar ranging
 - Required placement of retroreflectors



Retroreflector Array Sites





History

- Laser altimeter developed soon thereafter
 - NASA's AOL in 1977
- > Airborne, Shuttle, and satellite platforms
 - NASA ATM, Microaltimeter
 - SLA -01 and -02
 - MOLA, GLAS, MLA, LOLA



Applications

- Topographical mapping
- Agriculture and forestry
- Environmental research
- Urban planning
- Disaster evaluation
- Bathymetry







MOTIVATION



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Motivation

Limitations of traditional lidar bathymetry





System Bandwidth Limited Depth Measurement



Motivation



Motivation

- Dynamic water volume displacement [13,14]
- Science demands comprehensive water depth measurement capability



POLARIZATION SCATTER



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Polarization Scatter

Polarization-maintaining vs/ depolarizing targets



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INPHAMIS

Foundational setup for intrapulse phase modification induced by scattering^[17]



S. Mitchell, J. P. Thayer, and M. Hayman, "Polarization lidar for shallow water depth measurement," *Applied Optics*, **49** (2010)

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INPHAMIS

Evaluate the received Stokes vector





INtrapulse PHAse Modification Induced by Scattering







INPHAMIS

Laboratory demonstration







PROTOTYPE INSTRUMENT



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Prototype instrument

- Photon-counting polarization lidar for shallow water bathymetry
- Prototype technology demonstrator
- Designed to explore INPHAMIS beyond the laboratory







COTS design









- Instrument simulation
 - 300 m altitude, 10 m depth, random Poisson noise



Simulated TDC, 10 cm depth, "switching"



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Incorporating count PDF effects



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Incorporating count PDF effects







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