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Lidar for emergency response and management
Lidar

- **Light detection and ranging (optical analogue of radar):** Emits laser pulse and measures return trip distance
- **LiDARs are active remote sensors with source of energy:**
  - LASER (Light Amplification by the Stimulated Emission of Radiation)
  - Optical band: 255 nm to 1600 nm (typically 532 nm or 1064 nm for range finders)

Basics

- Laser pulses
- Geographically located
- Multiple returns

Images courtesy of OPTECH, Inc.
LiDAR market growth

- Academic:
  - Biggest Increases: Hyperspectral, SAR, and LiDAR in each sector
  - Biggest Decreases: Pan B/W film; Color Film; Color IR Film; Digital B/W

- Commercial:

- Government:
Accuracy of lidar data

- Vertical accuracy: ± 2-13 cm, with mean error of ± 6 cm (Jensen, 2000 - reference to Vaughn, 1996; Leigh et al., 2009)

- ± 10 cm compared to surveyed runway elevation (Jensen, 2000 - reference to Krabill, 1995)

- Horizontal accuracy not as good as vertical accuracy (e.g., less than 50 cm)
Lidar point classification

- Filtering algorithms - distinguish laser reflections from the ground, trees (green), and buildings (red)
- Construct “bald earth” topography, estimate vegetation heights, and identify artificial structures
Potential algorithm needs:

- Accurate and efficient *surface extraction* to *raster formats*
- *Compression* algorithms for real-time applications
- *Change detection* – pre- and post-disaster (quantifying change)
- *Automated feature extraction*: Buildings, structures, vegetation
- *Complex structures*, e.g., vegetation, built environments
...towards normalized surface models
Coastal areas change and erosion

Flood plain mapping – flood mapping in real-time and in terms of watershed topography

From U of TX and Optech
Lidar floodplain mapping
Harris County, TX
Multimodal Data Collects

- Structural data runs a thread through most disasters – flood plain, built or vegetation environment destruction, etc.
- Lidar can be fused with multiple modalities to better understand the 3rd dimension.
Where to next?

Determine *requirements* regarding…

- Disasters
- Algorithms
- Systems
- Acquisition parameters