Can You Hear Me Now?
An Evaluation of UDOT’s Avalanche Infrasound Detection System

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But first, a little background information:

Little Cottonwood Canyon Study – August 2006
Background information....

Little Cottonwood Transportation Study – Study Objectives

1. Reduce Little Cottonwood Canyon highway’s avalanche hazard index
2. Safely accommodate a variety of travel modes
3. Focus on environmentally sensitive solutions
4. Maintain/enhance economic viability
5. Reduce dependence on military artillery
6. Provide a range of short and long term recommendations
Background information...

Factors in the Avalanche Hazards Index

1. Width and depth of avalanches at the road
2. Frequency of avalanche occurrence
3. Number of avalanche paths
4. Spacing between paths
5. Winter traffic volume
6. Traffic Speed
Short Term Recommendations from the Little Cottonwood Canyon study

1. Infrasound Detection Devices
2. New artillery near White Pine Chutes
3. Variable message signs at Alta
4. Park & Ride wayfinding signs
5. ITS for parking management/canyon communications
6. Improvements to China Wall berm
7. Driveway metering at Snowbird test
8. Gaz-Ex above Snowbird Village
Figure 4: Natural Avalanches Reaching the Road: 1973 - 2008
Figure 5: Controlled Avalanches Reaching the Road: 1973 - 2008
Risk Reduction

Road
- Active
  - Gazox
  - Artillery
  - Infrasound
  - Forecasting Team
- Passive
  - Shields
  - Berms
  - Snow Nets
  - Realignment

Traffic
- Demand Reduction
- Parking Management
- Information System
- Traffic Flow
- Parking Lot Metrology
- Incident Management
Little Cottonwood Canyon Traffic Modeling Simulation
The story begins…
A nice sunny day…
The tram and the bunnies… business as usual…
And it snows...
Gets a little crazy…
Snow depth increases and cornices develop...
Avalanches occur...
Avalanche sweeps 9 in SUV off canyon road; no one hurt

St. Louis family unhurt in avalanche adventure

Swept from the road: An SUV with nine people inside hit by a
avalanche in Little Cottonwood Canyon, taking the family by
surprise as they drove down the road.

Dr. Kristin Strayton
1080 Canvas

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The day after clean up.
Avalanche Prevention and Detection Operations

Control work begins… Artillery, this is fun!
Gas-Ex Device up close
Gas-Ex Device in operation
Infrasound Listening Device
What is Infrasonic Avalanche Detection?

- A system to provide remote sensing of avalanche (and artillery) activity
- Avalanches produce super low frequency sounds; too low for the human ear
- Sounds can be picked up and transmitted via radio to a controller/monitor
Who Developed the Infrasonic System?

• Avalanche Infrasonic system was developed by Ernie Scott at Intermountain Laboratories, Sheridan Wyoming

• Started with a grant from the National Oceanic and Atmospheric Administration (NOAA) in 2002
Project Evaluation Team

UDOT Personnel:

• Abdul Wakil
• Liam Fitzgerald
• Ralph Patterson
• Paul Garske
• Chris Covington
• Adam Naisbitt

Principal Investigators from Fehr & Peers:

• Maria Vyas
• Jon Nepstad
Research Evaluation Objectives

1. Does the Infrasonic provide reliable early warning of natural avalanche cycles and confirm control operations?

2. Does the Infrasonic reduce costs for UDOT?

3. How could the Infrasonic system be improved?

4. Would an expanded Infrasonic system benefit UDOT (or other DOTs)?
Research Methodology

• Questionnaire for users
• Field review during setup
• Review of other location (Teton Pass, WY)
• Review of available competing systems
Tower for Power

Inside the Cabinet
Setting it up – preseason
Infrasonic Event
Infrasonic Event

Raw data from 3 sensor arrays
Infrasonic Event

Plots showing infrasound signals
Infrasonic Event

Correlation of infrasound signals shows strength of alignment – stronger likelihood of avalanche event.
Infrasonic Event

Yellow areas highlight probable avalanche activity
Infrasonic Event

Azimuth data shows path of travel
Infrasonic Event

Probably not an avalanche?
Yellow bin (discriminations).

Probably an avalanche?
Red bin (identifications).
Conclusions of the Research

1. Does the Infrasonic provide reliable early warning of natural avalanche cycles and confirm control operations?

Yes, on both counts.

Before: only knew of avalanche if it was seen/confirmed visually.
Now: can verify time/location of natural avalanches.
Also: can now verify whether control efforts hit target, whether detonation occurred, and if avalanche was triggered.
Conclusions of the Research

2. Does the Infrasonic reduce costs for UDOT?

Yes, although difficult to quantify.

Reduces costs in terms of:

• Human safety (traveling public)
• Human safety, again (UDOT avalanche control employees)
• Resort economics (duration of road closures)
• More efficient decision making (Shoot again? Open the road?)
Conclusions of the Research

3. How could the Infrasonic system be improved?

• Communication via automatic radio notification
• Ongoing software technical support via IML
• Ongoing brush-clearing and maintenance at sensor array sites
• Evaluate hose materials options (tendency to freeze)
Conclusions of the Research

4. Would an expanded Infrasonic system benefit UDOT (or other DOTs or Users)?

Yes, absolutely.

Potential locations:
• Above the Town of Alta
• Snowbird Village
• Little Pine – Snowbird Entry 4
• Slide Canyon, Provo Canyon
QUESTIONS?