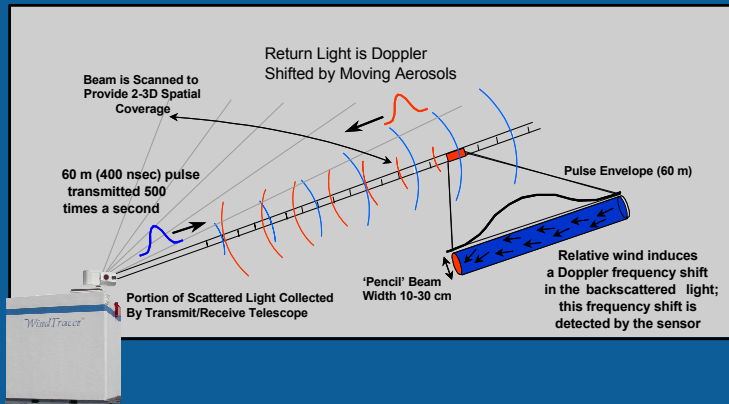


# Maturation and Application of Operational Doppler Lidar for Meteorological Applications

Stephen Hannon, James Roby  
 CLR Photonics, Inc., a division of Coherent Technologies, Inc.

## How Doppler Lidar Works

**Doppler Lidar = Infrared Doppler Radar**



**Infrared:** Instead of raindrops, we use natural particulates (one millionth of a meter in size)

**Doppler:** velocity/wind sensing (strength)

**Radar:** accurate position information

## Hong Kong International Airport

Installed June 2002

Windshear system works best in least needed times

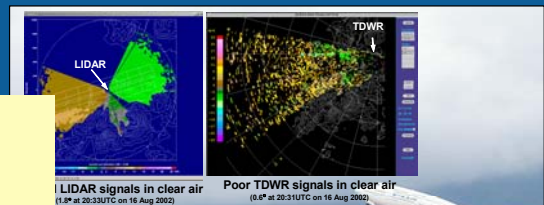
ANGELA LI

Eighty-three per cent of pilot reports of windshear at Chek Lap Kok are associated with dry weather, it has emerged.

Eighty-three per cent of pilot reports of windshear at Chek Lap Kok are associated with dry weather, it has emerged.

Pre-WT installation article

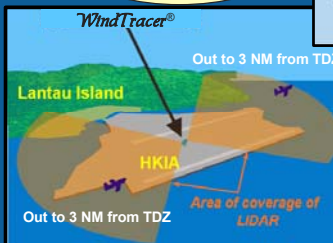
*WindTracer*® installed to address 83% of HKIA windshear conditions



the *WindTracer*® and the TDWR], in combination, will enable comprehensive detection of wind shear in all weather conditions."

"[The *WindTracer*®] issued an accurate wind shear alert an hour before it happened."

Dr. H.K. Lam, Director HKO  
 13 November 2002, South China Morning Post



# Wind Shear and Turbulence Alerting

Microbursts, gust fronts, sea breezes, and terrain-induced wind shear and turbulence pose hazards to aircraft in the terminal area



Microburst Wind Shear

Pulsed Doppler Lidar scans and collects distributions of radial velocity measurements

These measurements are processed to map the hazard - strength and location

Key benefits provided by pulsed Doppler Lidar:

- negligible clutter – no side lobes
- high spatial resolution, high accuracy
- zero land acquisition costs
- similar data formats provide for ease of integration with existing radar data streams (e.g., TDWR, ITWS)

## Sample Event: 3 September 2004 Microburst at JeffCo Airport

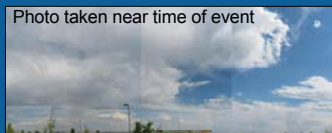
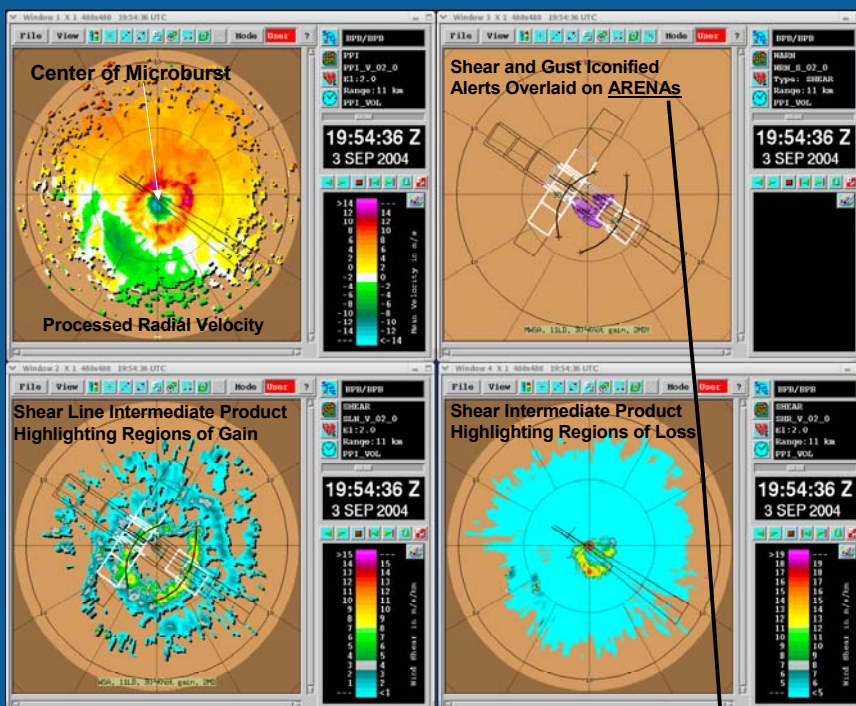


Photo taken near time of event



Graphical Situation & Virtual Ribbon Displays

“Runway 11 right departure: microburst alert, 50 knot loss, 1 mile departure”

## Automated Hazard Alerting

```

File Size
CF999 99G99 0826 ALM ON
11LA MBA 50K- RWY 999 99
11RA WSA 30K+ RWY 999 99
11TD MRA 50K- RWY 999 99
11RD MBA 50K- IMD 999 99
02-A MBA 50K- IMF 999 99
02-D MBA 50K- RWY 999 99
    
```

# Wake Vortex Sensing Supports FAA Pursuit of Capacity Enhancing Procedures

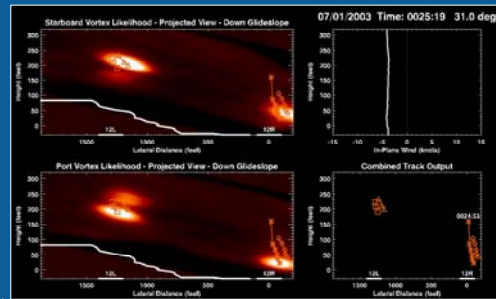
- Closely Spaced Parallel Runways
- Departures
  - Intersecting Runways
  - In-Trail Arrivals

Beneficial, phased solutions for specific problems within 3-7 yrs

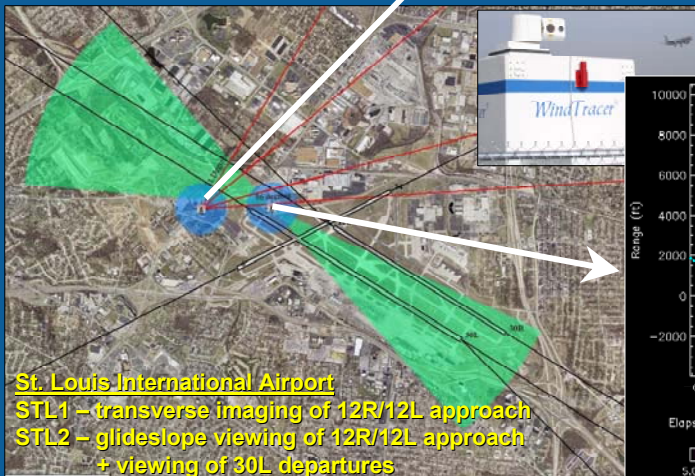
Joint program with NASA

Procedure development  
Data gathering and evaluation  
Integrated operational solutions

**Pulsed Lidar being used now to gather necessary wake safety data at STL**

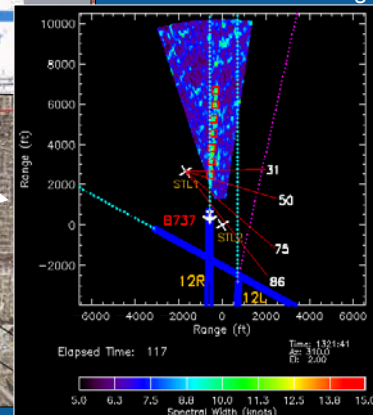


STL1 Transverse View  
Detection and Tracking



St. Louis International Airport  
STL1 – transverse imaging of 12R/12L approach  
STL2 – glideslope viewing of 12R/12L approach  
+ viewing of 30L departures

STL2 Glideslope View  
Detection and Tracking



## Summary

### Pulsed Doppler Lidar offers key & unique benefits

- Dry air (low dBZ) capability with clutter-free hazard detection
- High-density, glide-slope coverage and zero land acquisition costs
- Same sensor detects and tracks aircraft wakes

### Improved terminal area wind hazard situation awareness

- International airports adopting the technology: HKIA installed mid 2002
- SIGMET/IRIS integration demonstrates capability for automated alerting
- Airports benefit significantly with an integrated solution, especially those with limited/no wind hazard alerting infrastructure

### Wake turbulence research program relying on Doppler Lidar

- Joint FAA/NASA program: safe capacity-enhancing procedures
- STL WindTracer® installations March 2003, August 2004