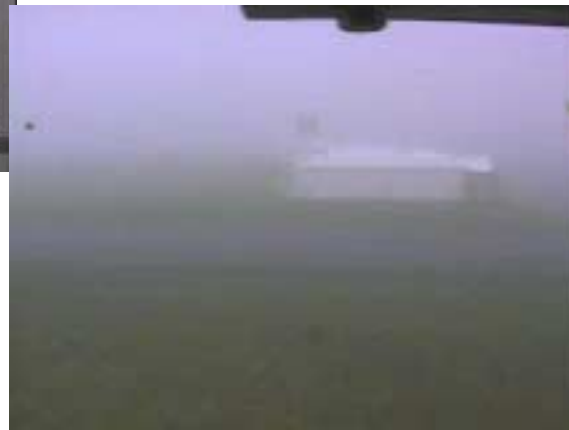

Using Camera Imagery to Measure Visibility & Fog



FY2001

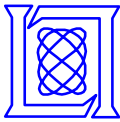
FHWA Review

Robert Hallowell

MIT Lincoln Laboratory

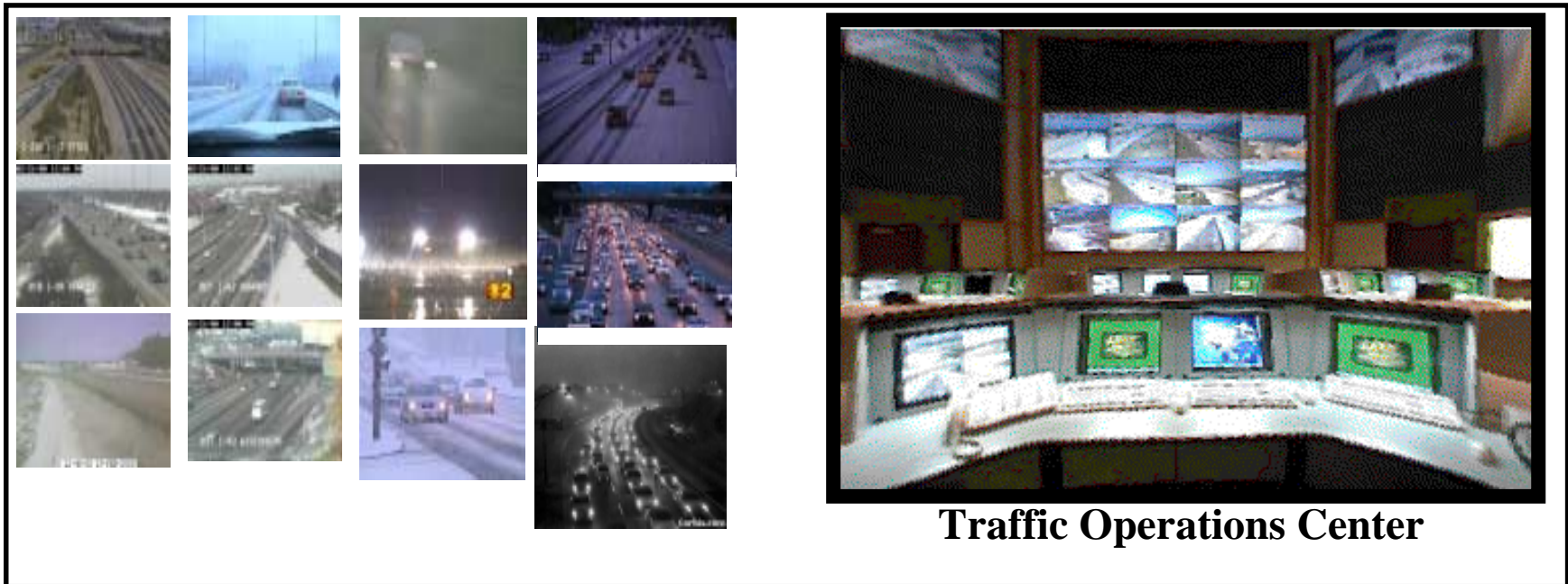
50
years

MIT
LINCOLN LAB



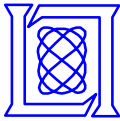
Motivation

Thousands of Cameras Deployed Along America's Highway System




Traffic Operations Center

- **Potential transportation uses:**
 - Additional surface sensor for verifying visibility/fog
 - Alert travelers to unsafe conditions (via VMS)
 - Prioritize which cameras are displayed to TMC (or to web users)
 - Alert maintenance crews when a camera is covered/blocked



Goals

- Automatically Measure Visibility and Detect Fog Utilizing Standard Visible Camera Imagery



Visibility(East): **1 km : ± 0.1 km**

Roadway Conditions: **Partially Snow Covered**

Precipitation: **Moderate Snow**

Visibility(km)
>10
>5
1-5
0.0-1.0

Visibility(West): **0.2 km : ± 0.1 km**
Fog: **Heavy Fog : Thickening**

Fog Description

Heavy
Moderate
Light

Roadway Conditions: **Clear**

Precipitation: **None**





How far can I see ?

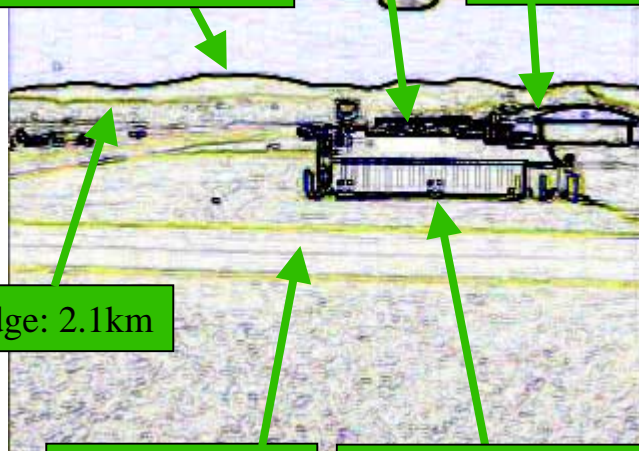


Esposito Hangar: 0.4km



Taconic Ridge Line: 6.7km

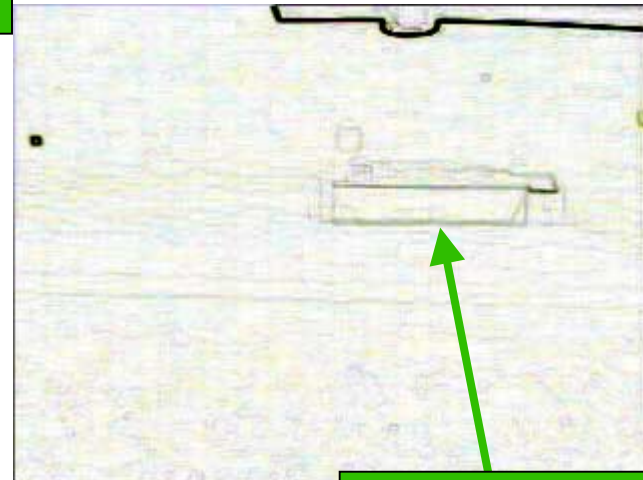
Hangar: 0.2km



Near Ridge: 2.1km

Road: 0.030km

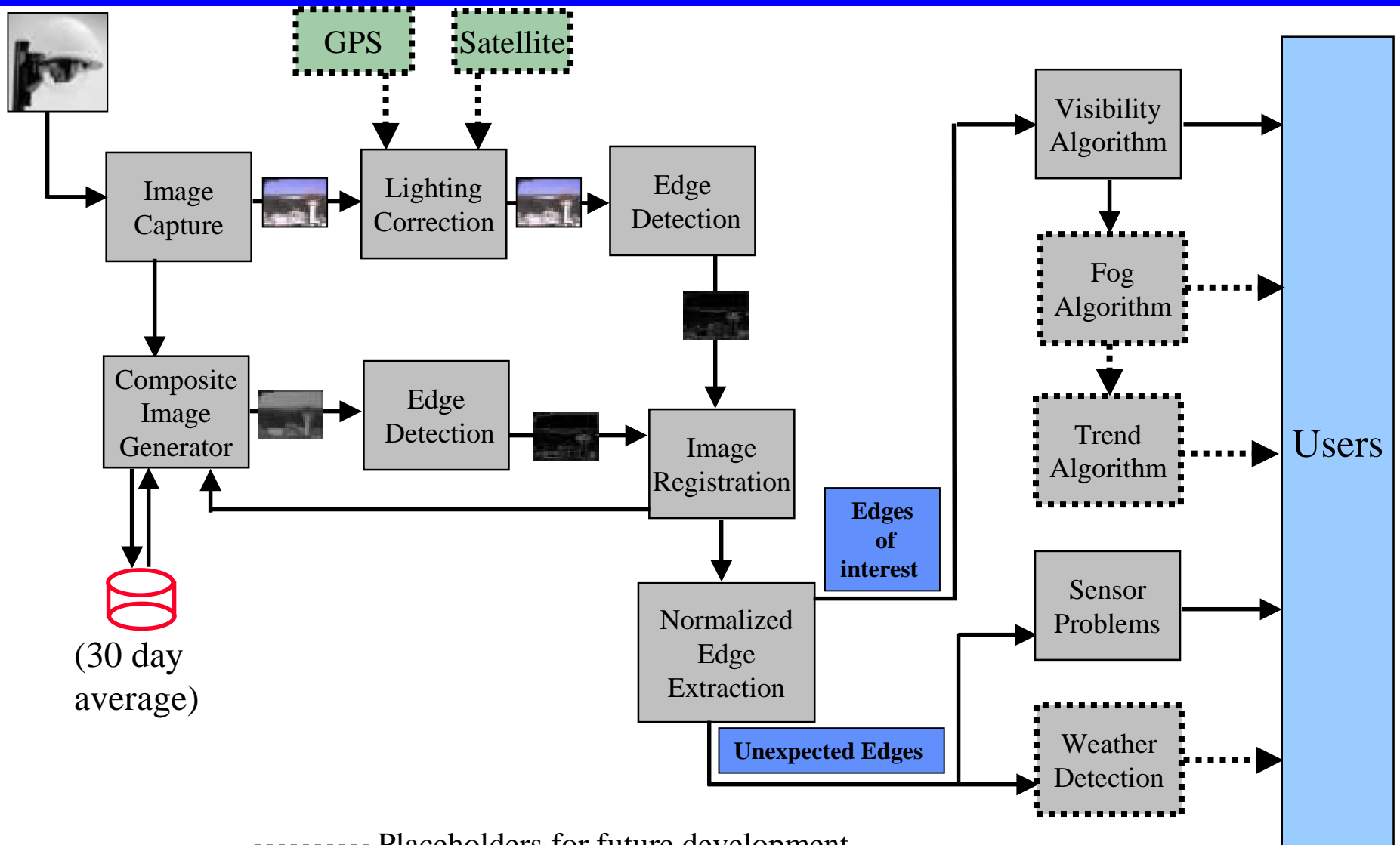
Gas Tanks: 0.042km

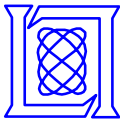


Gas Tanks: 0.042km

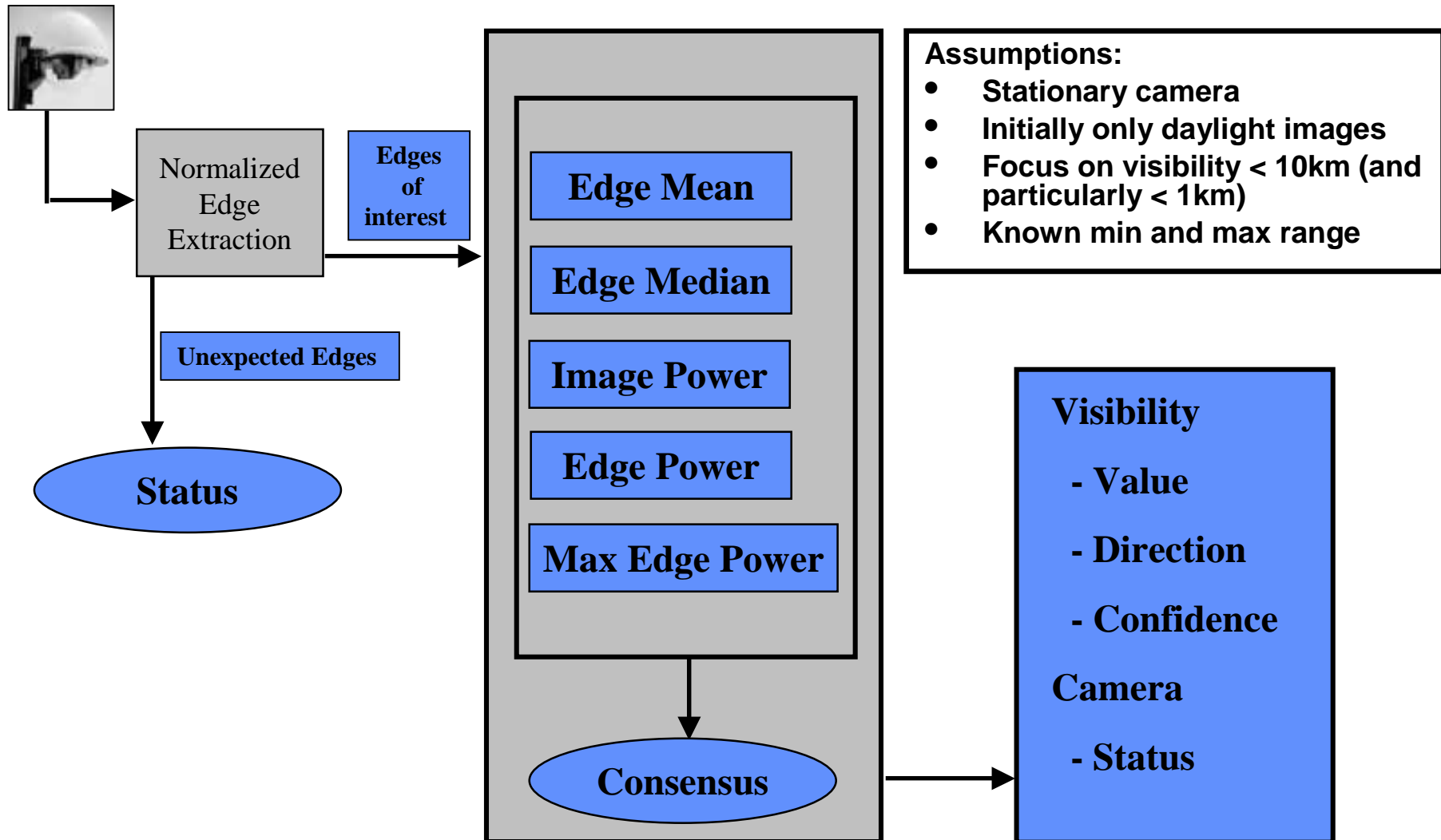


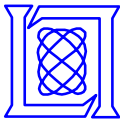
Algorithm Flow Chart



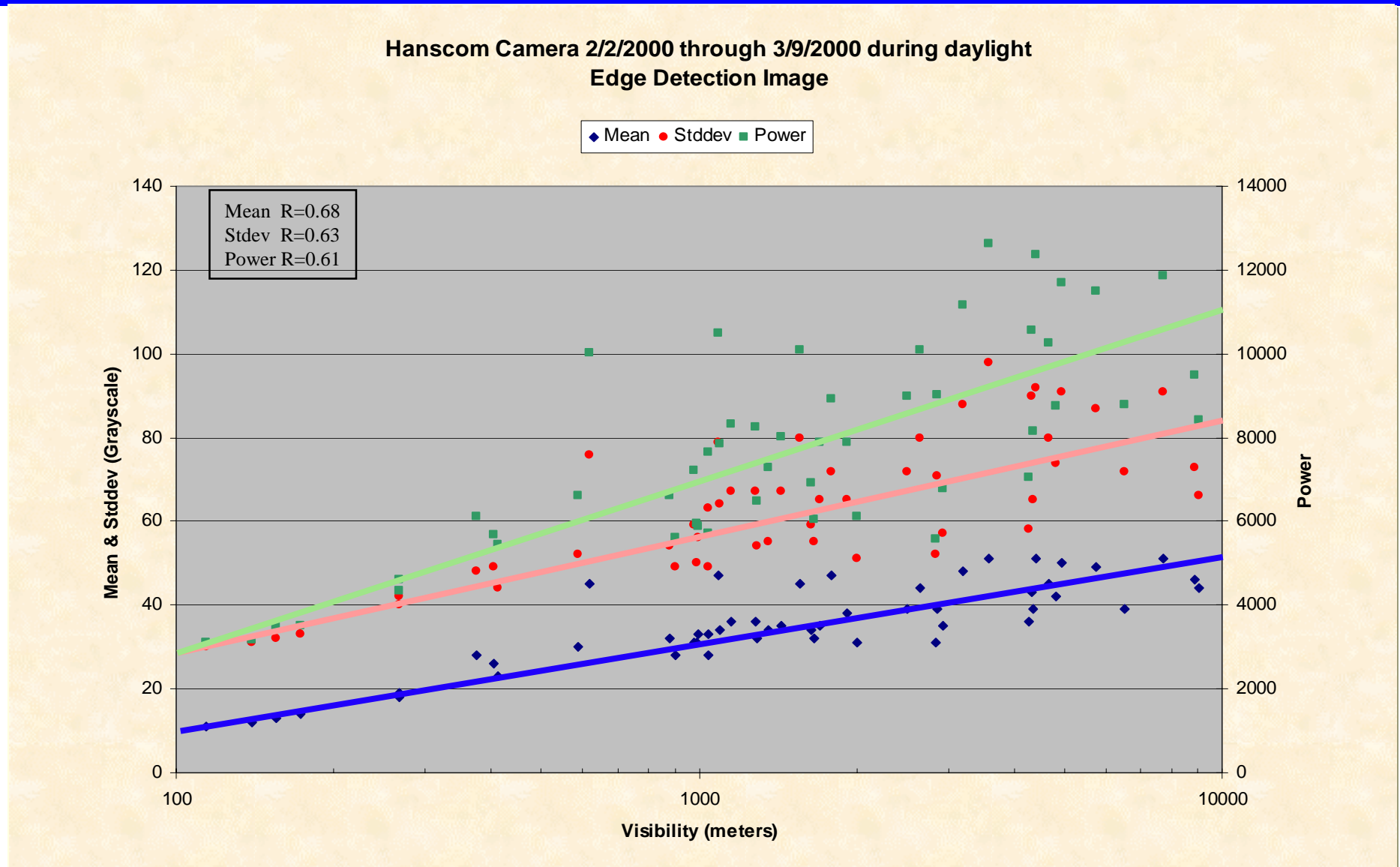


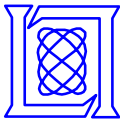
Visibility Algorithm





Multiple Determination Techniques

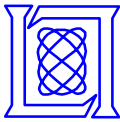




Video Visibility – Preliminary Tests

		Video Estimated Visibility (km)			
		<1	1-5	5-10	≥ 10
ASOS Visibility (km)	<1	28	2	0	0
	1-5	1	24	11	6
	5-10	0	10	64	32
	≥ 10	0	46	174	663

Mt. Greylock, MA Images 7/1-10/31/2000



Archiving State DOT Camera Imagery

- Archived Since 4/2001
- Every 20 minutes

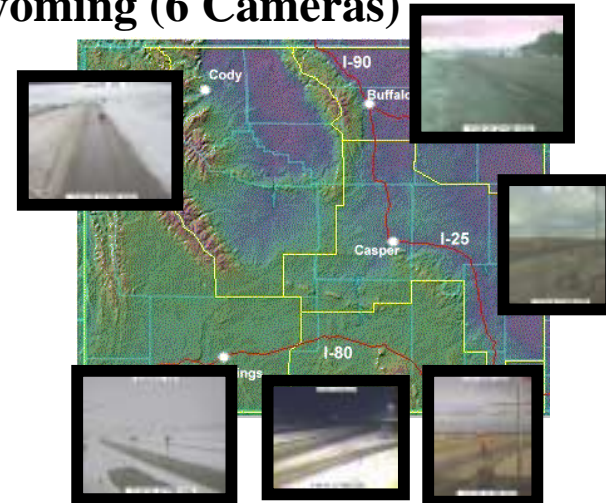
Utah (SLC) 150+ Cameras



Colorado (6-8 Cameras)



Wyoming (6 Cameras)





Final Status - Future Efforts

Final Status

- Overall algorithm specified at a high level
 - Visibility estimates have been generated
 - Fog and covered/blocked image detection are in concept stage
- An experimental version developed in IDL (software package)
 - Initial success for visibility (>70% CSI for all ranges, >90% CSI <1km)
- However, work still required for generic application of algorithm to new sites/images and proof-of-concept for other detection algorithms

• Future Work

- There is no FHWA funding for this project in FY02
- MIT/LL will continue some development with internal funds
- State DOTs expressed interest in both the warning function (particularly fog) and system maintenance potential (broken/blocked cameras) of the system