Visual Guidance/Runway Incursion Prevention

Research & Development

Update

IESALC Spring meeting May 8, 2014
Washington DC

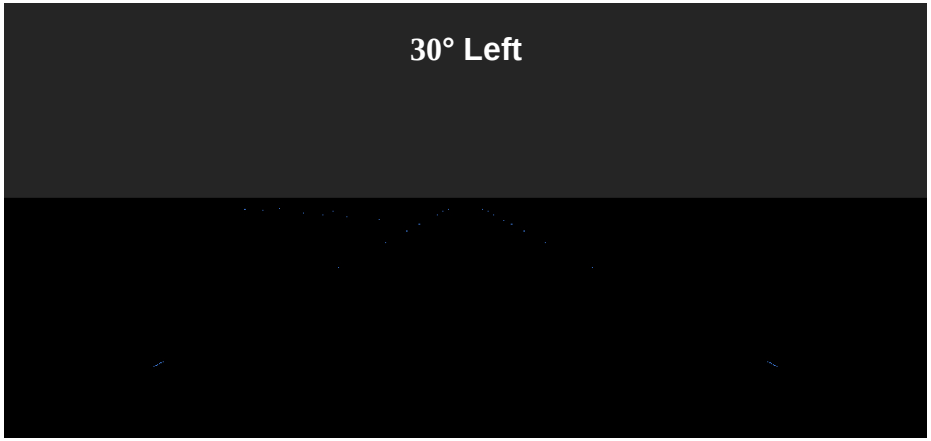
TOPICS

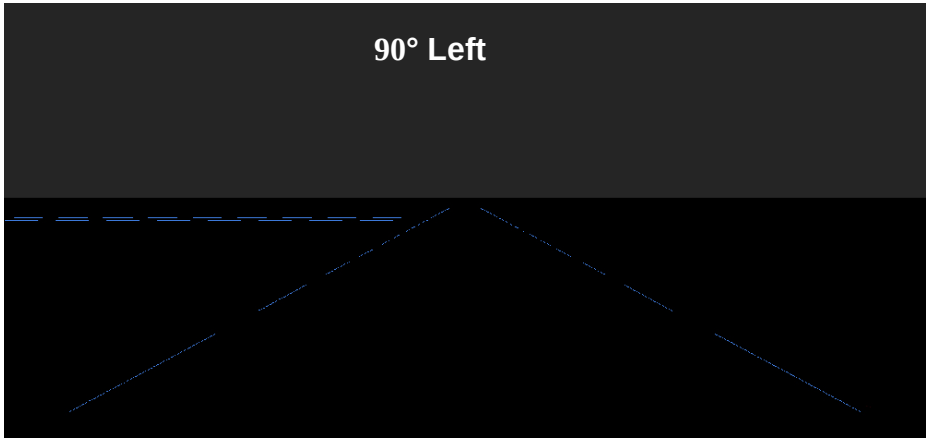
1. Airport Linear Source Visual Aid
2. Frangible Connections and Structures
3. Electrical Infrastructure Research
4. Constant Current Regulator Loading
5. Visual Aids for Airport Construction
6. EMAS Lighting, Signs and Marking
7. RSA/Approach Signs and Markings

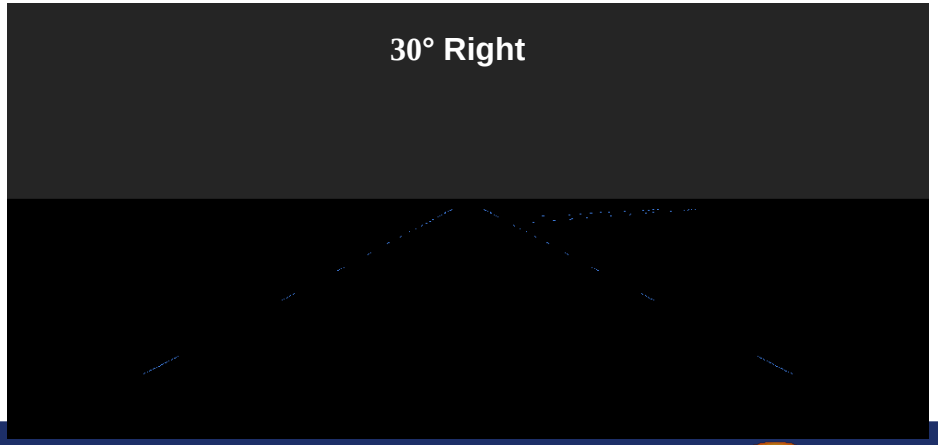
Airport Linear Source Visual Aid

Experiment 1 Stimuli – “No Noise”

- Linear element spacing: 50, 100, 200 ft
- Linear element length: 2, 8, 32 ft
- Configurations: 90º (low-speed taxiway exit) and 30º (high-speed taxiway exit), left and right

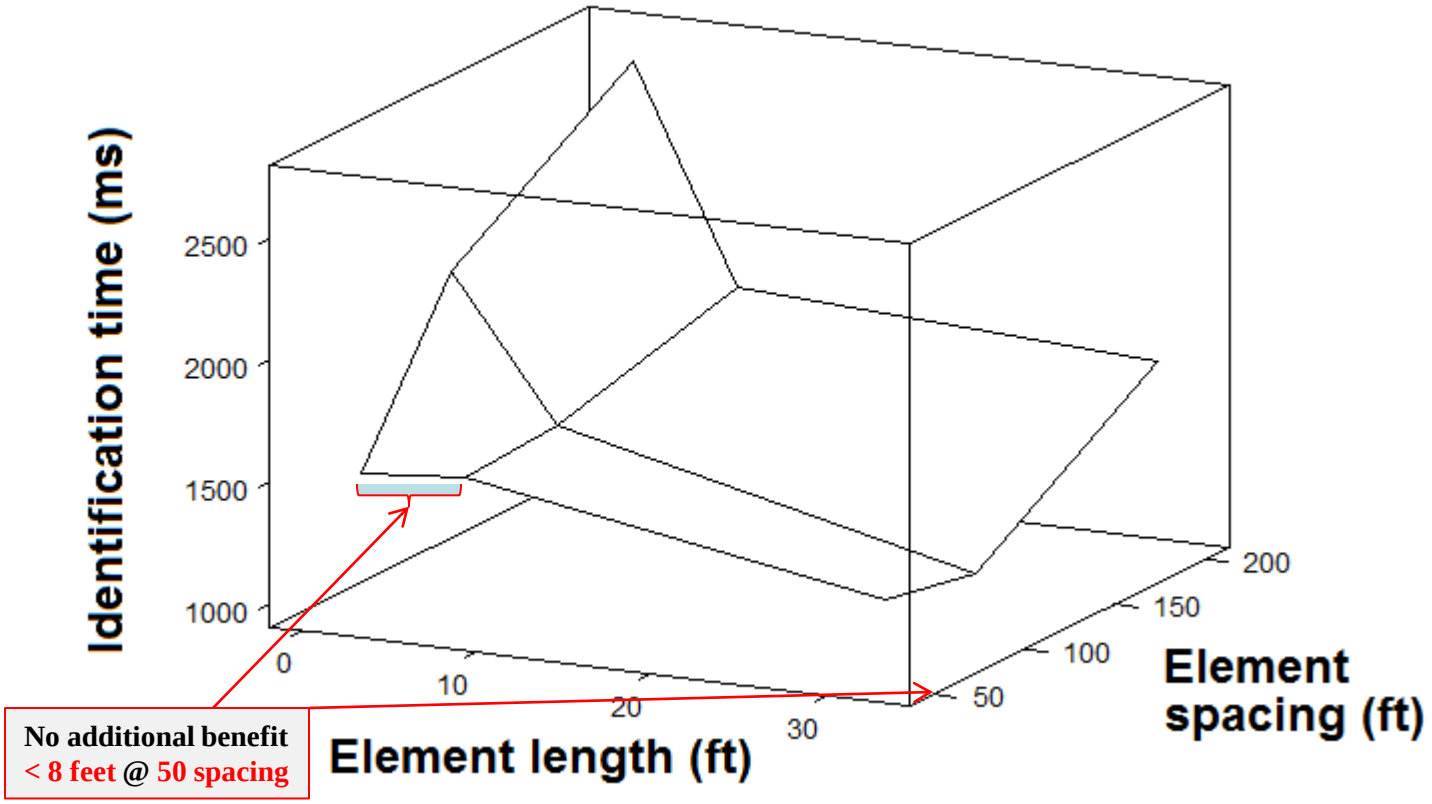




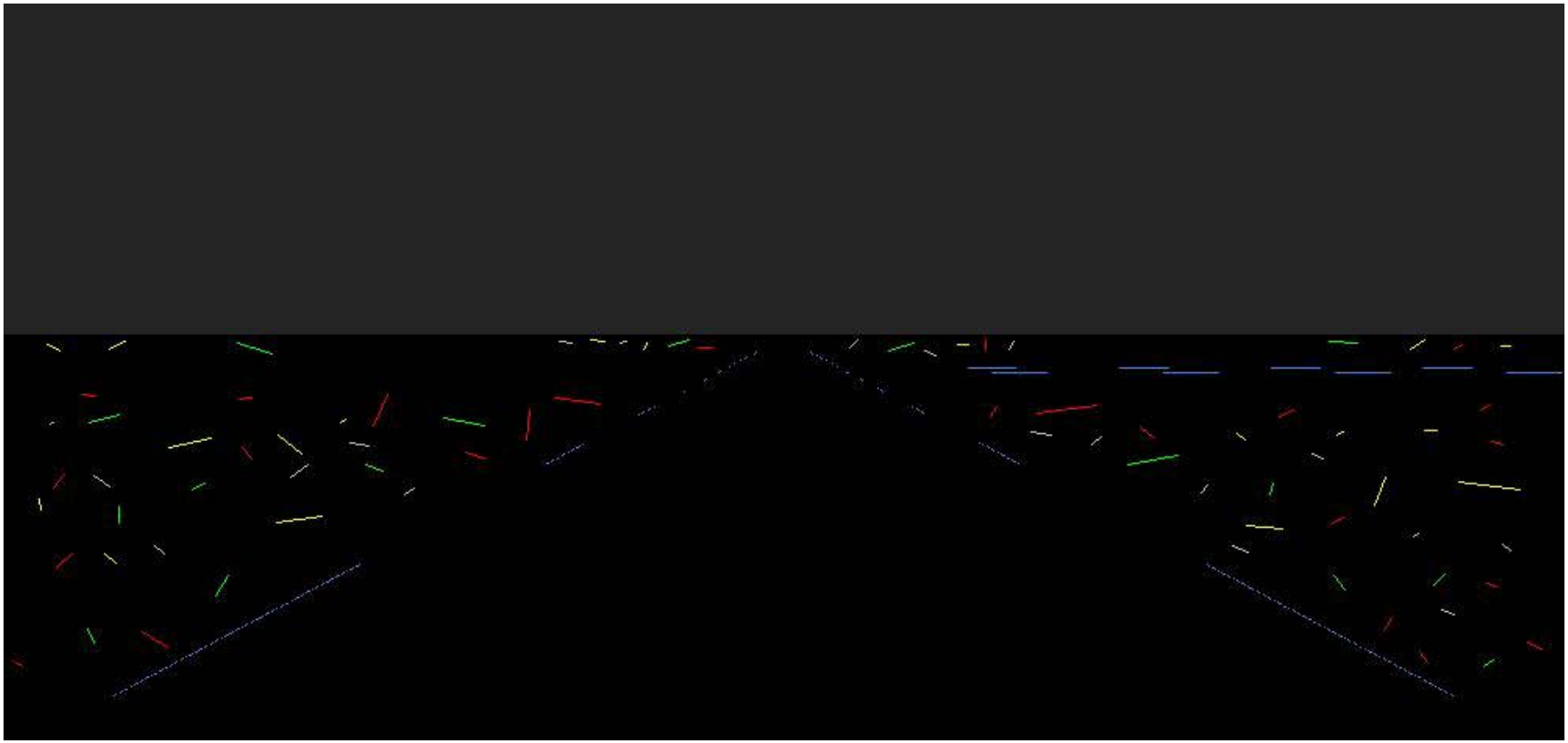


Experiment 1 Results – No Noise

Accuracy was always > 90%

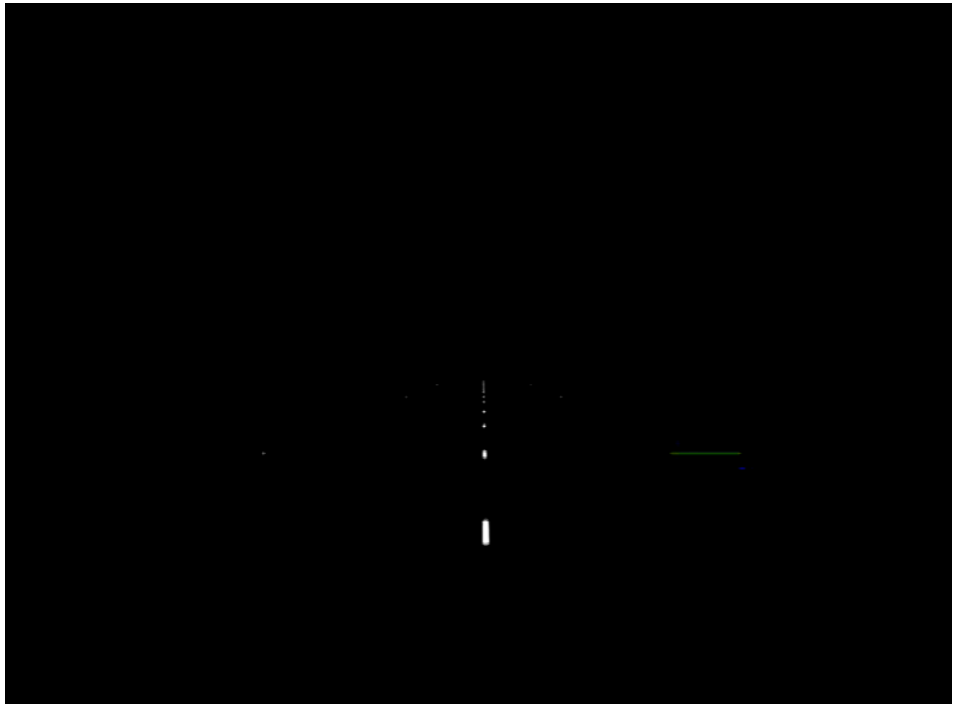


Experiment 2 Stimuli – Visual Noise



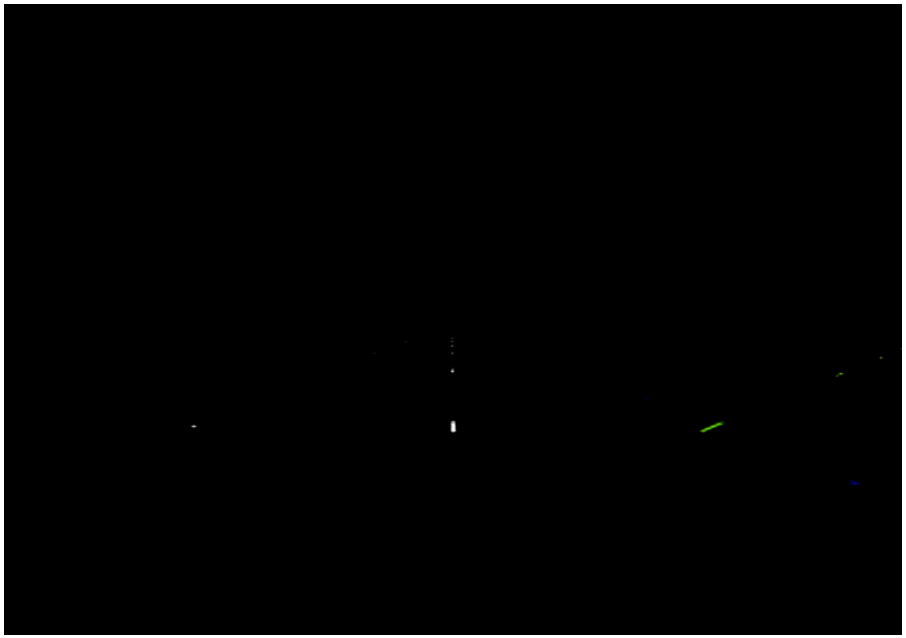
Experiment 3 - Dynamic

- Dynamic animation starting from 2000 ft away, 50 mph
- 30º/90º left/right taxiway from runway
- Centerline delineation (white/runway, green/taxiway)
- 2, 8 or 32 ft element length; 50, 100, 200 ft spacing



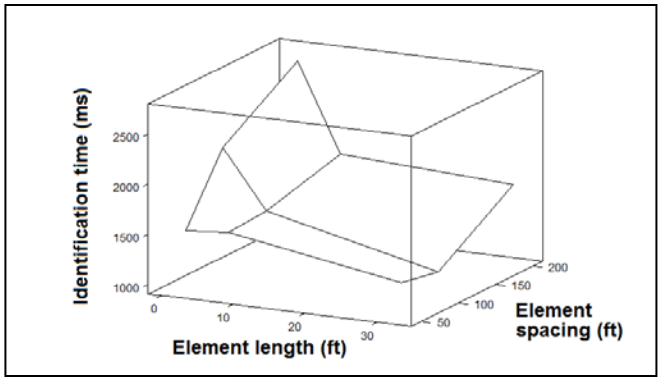
Experiment 4 – Lower Intensity

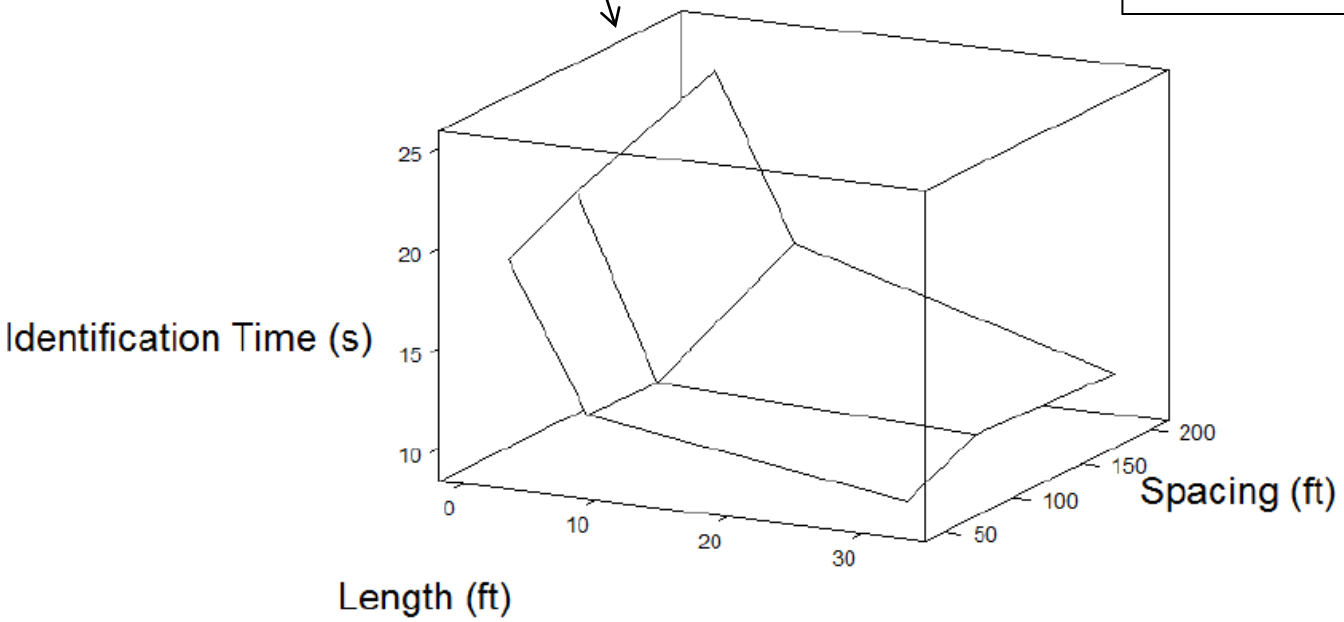
- Same as experiment 3 except luminance was decreased to:
  - White 30 cd/m²
  - Green 18 cd/m²
  - Blue 1.8 cd/m²
  - Background 0.25 cd/m²



Experiment 2 to 4 Results

Same correlation between Length and Spacing to Reaction Time in all experiments

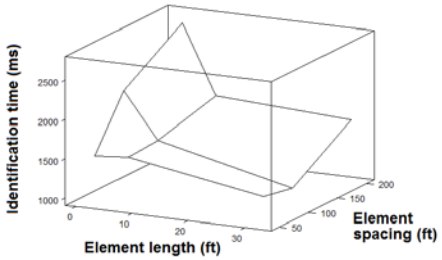




Correlated (r^2=0.69) to Experiment 1 & 2 results

Factor: 8.8x

Developed Predictive Response Time Equation



$$RT\ (ms) = 286 - 607 \log L + 989 \log S$$

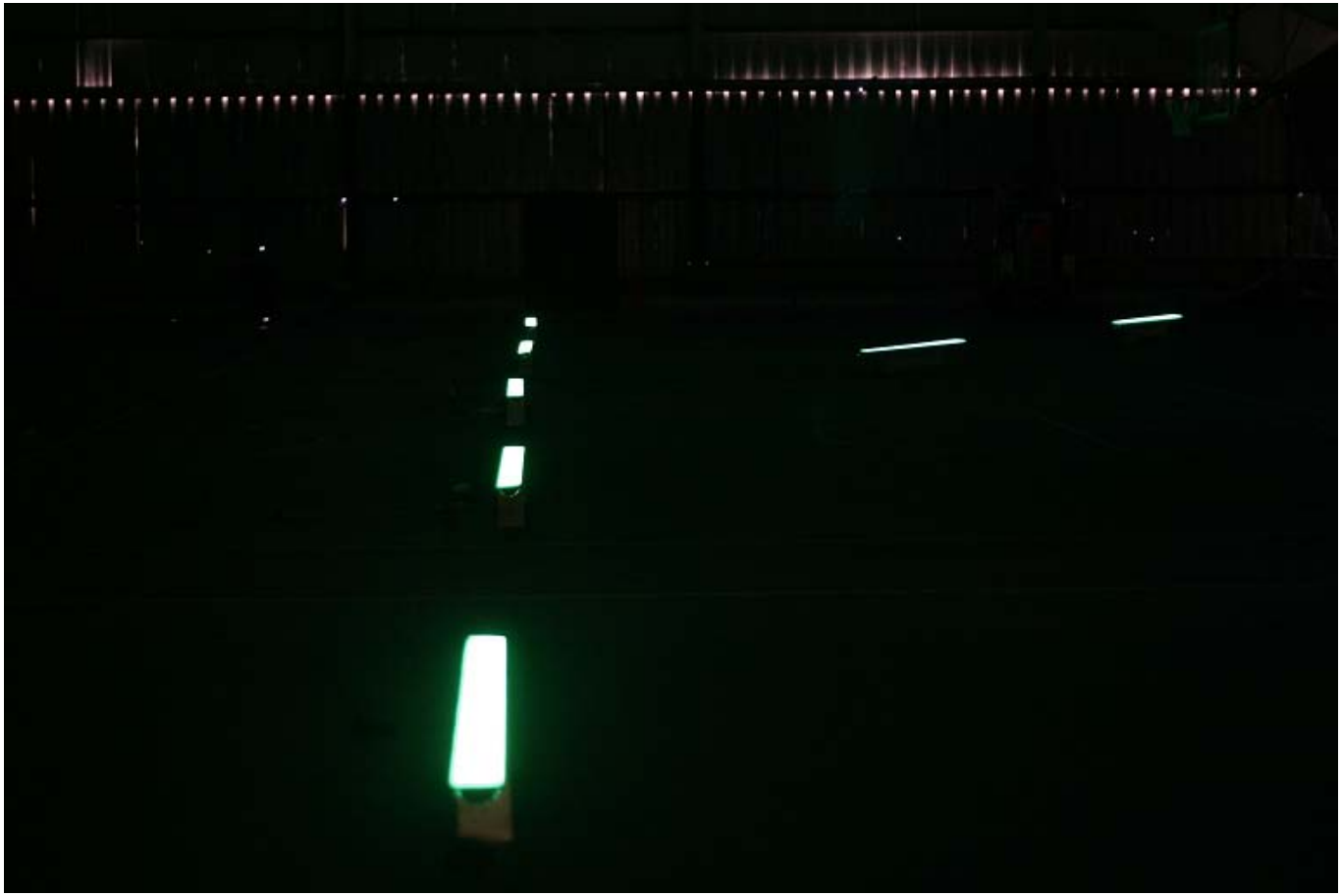
Combinations of delineation element length and spacing to achieve the same relative response times expected from 2-ft-long delineation elements spaced at 50 ft and 100 ft.

Base Case 1	Element length	2 ft	**6.2 ft**	**12.0 ft**	**19.2 ft**
	Element spacing	50 ft	100 ft	150 ft	200 ft
	Relative response time	1784 ms	1784 ms	1784 ms	1784 ms
Base Case 2	Element length		2 ft	**3.9 ft**	**6.2 ft**
	Element spacing		100 ft	150 ft	200 ft
	Relative response time		2081 ms	2081 ms	2081 ms

Validation Study

- Validation study was conducted using the 9 linear segments created with blue and green LED sources.
- For the experiment, prototype linear light source segments in 2-ft, 4-ft, and 8-ft lengths were used at a 25-ft and 100-ft spacing.
- The experiment was conducted in a large and enclosed space where the ambient illumination could be turned off.
- The results were consistent with the laboratory experiments using computer displayed images.

Validation Study



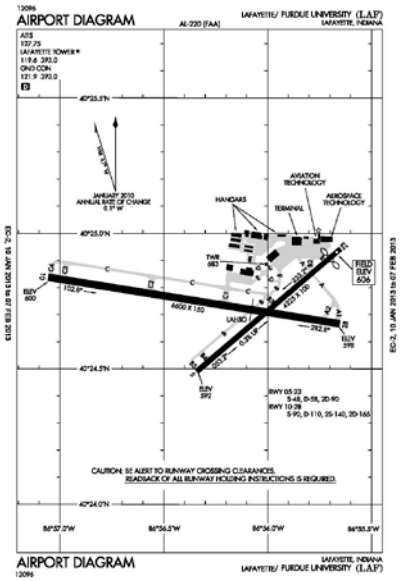
View of one of the test conditions as presented to observers that participated in the validation field experiment.

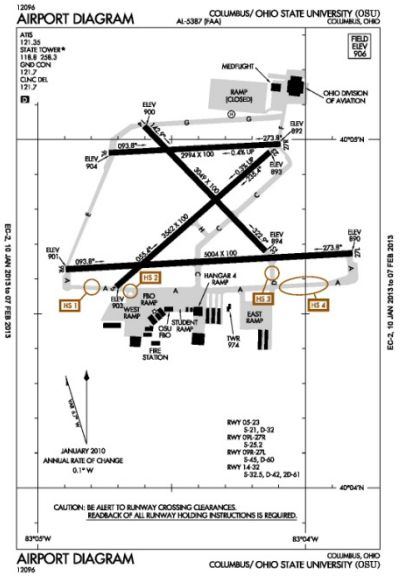
PHASE THREE

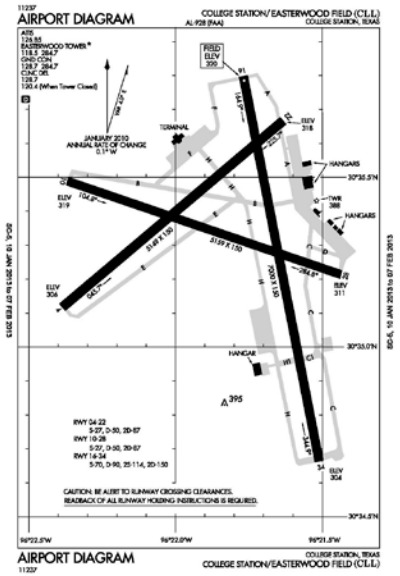
- **Task 1: Conduct a simulation evaluation. (4 months)**
  - **Utilizing the FAA Technical Center's Simulation facility.**

PHASE THREE

- **Task 2: Conduct a field evaluation. (6 months)**
  - **Utilizing the Partnership to Enhance General Aviation Safety, Accessibility and Sustainability (PEGASAS) Center of Excellence.**
  - **Three of the six core members also own and operate their own airports (Purdue, Ohio State, Texas A&M).**







Schedule

Activity	Completion
Test Plan	02/28/12
Phase 1	09/30/12
Analysis/Decision Point	10/31/12
Phase 2	02/15/13
Analysis/Decision Point	02/27/13
Extended Phase 2	**07/31/13**
Phase 3	**06/30/15**
Final Report to Sponsor	**09/30/15**

Frangible Connections and Structures

Research on Frangible Connections and Structures

Due to the wide variety of test methods/procedures utilized in the past, it is necessary to re-evaluate the FAA requirements for frangible testing.

This will enable a path to simplification/ standardization of testing procedures and identify potential areas that require clarification.

By fully understanding the current condition of the governing requirements, a standardized procedure can be developed that will eliminate the large variety of differences in test procedures and allow comparison between all tests performed on different products.

Frangible Structures

- Equipment located in airfield safety areas (e.g. RSAs and TSAs) must be mounted on frangible supports.
- Frangible mechanisms can be designed to withstand high wind loads but remain very sensitive to impact loads.
- Frangible mechanisms tend to be directional in strength, i.e. they carry high tension and bending but very low shear.

Types of Frangible Connections

Application of Fuse Bolts

Examples of Frangible Couplings

Research on Frangible Connections and Structures

Phase I:

- Task 1 Requirements Analysis ← **Completed**
- **Task 2 Finite Element Development** ← **On-going**
- **Task 3 Test Setup Development** ← **On-going**

Phase II:

- **Task 4 Test Plans / Procedures Development**
- **Task 5 Test Setup Fabrication**
- **Task 6 Dynamic Testing and Evaluation**
- **Task 7 Guidebook Development**

Electrical Infrastructure Research

EIRT Testing Team Recommended Two Paths

- **Path # 1:**
  - **Fixture Centric**
    - **An airfield lighting architecture where the fixture controls its intensity**

- **Path # 2:**
  - **Vault Centric**
    - **An airfield lighting architecture that directly controls the fixture intensity from the power source in the vault(same as the traditional 6.6 amp)**

Roadmap Testing Phase

✈ ***Alpha testing at FAATC, May 2014***

- **Integration including mixing of product**
- **Fixtures will be instrumented and monitored by FAA equipment to determine performance**
- **Identify any deficiencies, or adjustments to be made**

✈ ***Beta testing at PEGASAS Airport July, 2014***

- **Similar set up as alpha testing**
- **Large circuit**
- **Legacy mode will be available in case there is an issue with the circuit**
- **Report (Date TBD)**

Investigation of Maximum Constant Current Regulator Loading

Project Objectives

- Investigate reports of overloaded CCRs relating to a predominance of constant Volt-Amperes (VA) sign
- Investigate if restrictive maximum loading at lower steps for CCRs is specific for a particular CCR technology
- Determine any relationship between lower step loading and the use of Light Emitting Diode (LED) fixtures
- Determine if the lighting system power factor has an adverse effect upon the CCR
- Investigate the impact on power factor and input power when CCRs are under loaded.

Test Locations

- Louis Armstrong New Orleans International Airport (MSY), New Orleans, LA
- George Bush Intercontinental/Houston Airport (IAH), Houston, TX
- Ryan Field Airport (RYN), Tucson, AZ

Schedule

Event/Deliverable	Tentative Completion Dates
Airport Circuit Investigation/Testing	April 4, 2014
FAATC Post Investigation/Testing	July 31, 2014
Analysis/Draft Report	August 29, 2014
Final Report/Recommendations	November 15, 2014

Visual Aids for Airport Construction

Taxiway or Movement Areas Construction Signs

Airway Facilities Tower Integration Laboratory (AFTIL)

Evaluation of character legend colors

Field Evaluation Phase - Airports

- TF Green State Airport (PVD)
- Long Island Macarthur Airport (ISP)
- Chicago O'Hare Airport (ORD)
- Orlando Sanford International Airport (SFB)
- Portland International Airport (PDX)

Construction Ahead - PVD

Construction on Ramp - PDX

Construction Ahead - SFB

Findings

- "CONSTRUCTION AHEAD" sign - 109 respondents
  - 87% sign was conspicuous.
  - 88% sign was comprehensible at an adequate distance.
  - 90% sign adequately notified them of the existing construction.

- "CONSTRUCTION ON RAMP" sign - 51 respondents
  - 92% sign was conspicuous.
  - 88% sign was comprehensible at an adequate distance.
  - 94% sign adequately notified them of the existing construction.

Questions/Comments?