MALSR LED AND
INFRARED (IR) Measuring the IR

Presented by
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Overview

- Background
- Key Specifications
- IR measurements
- Spectrometer
- Pyranometer
- Filters to Simulate fog
- IR Cameras
- Enhanced Vision Systems
- Recommendations

Definitions

- Watts/Sr-power per unit solid angle.
- Solid angle-dimensionless unit of measurement called a steridian.
- Irradiance-power incident on a surface.
- Radiance-power per unit solid angle per unit.
- Spectral Radiance-power emitted from a surface per wavelength or frequency
- Spectral Irradiance-power incident from a surface per wavelength or frequency

Definitions

□ Neutral Density filter-ND filter is a filter that reduces and/or modifies intensity of all wavelengths or colors of light equally, giving no changes in hue of color rendition.

Disclaimer

- No discussion today of the LED/IR fixture design
- No discussion today of the confidence test results
- No discussion of the performance of the Enhanced Flight Vision Systems

Enhanced Vision Systems

Current EVS

- Peak between 1.3 and 1.8 microns
- Peak between 3.4 and 4.2 microns
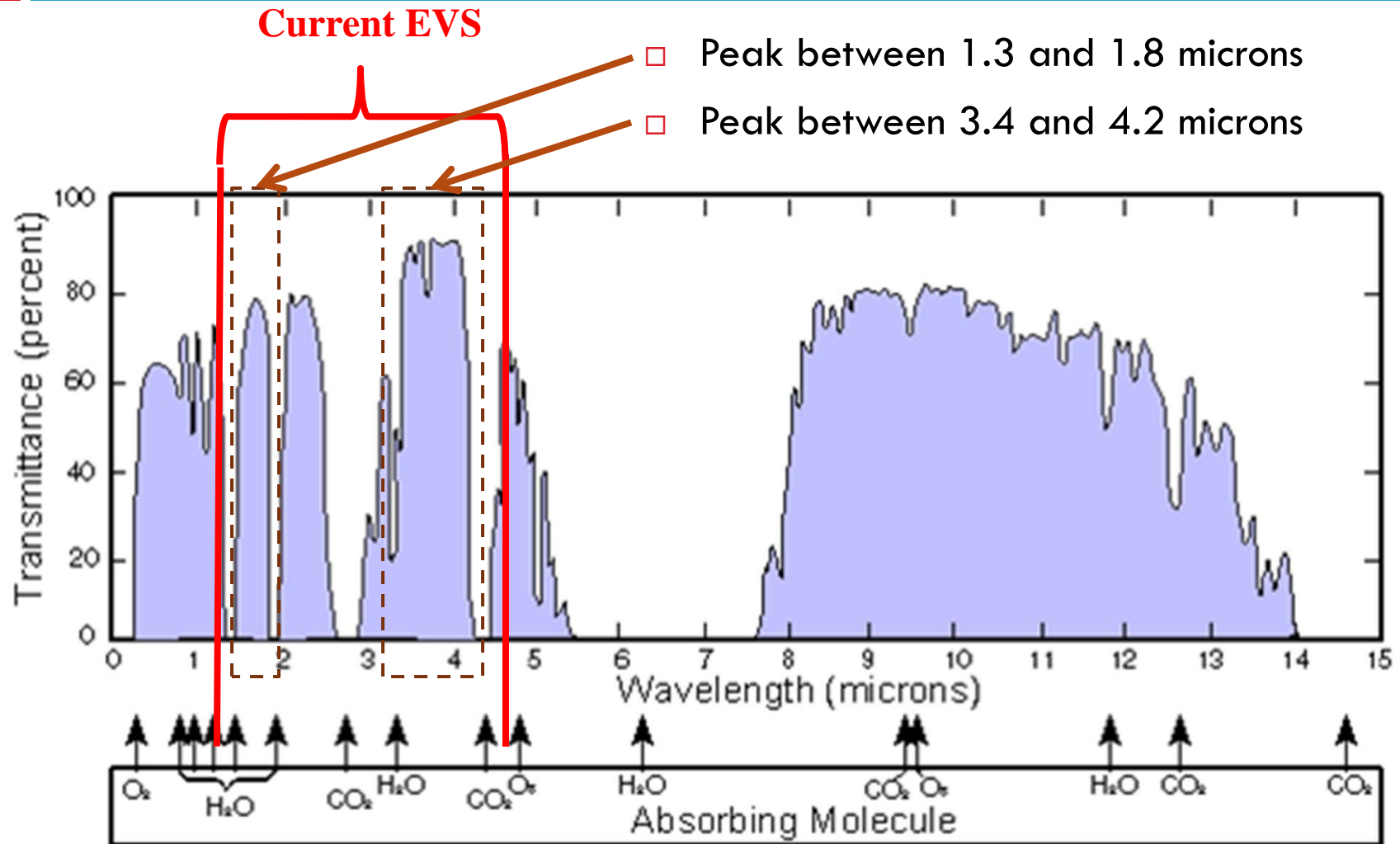
PRD Analysis – Infrared Requirements

- Infrared Requirements Per LED-PRD-001
  - PAR 56 Specification
    - Between 1,300 nm and 2,400 nm greater than 21.0 W/sr
  - PAR 38 Specification
    - Between 1,300 nm and 2,400 nm greater than 8.2 W/sr
  - Based on Radio Spectrometer studies of lamps
  - Starting point for design of the IR sources

IR Measurements

Measurements needed to be made to characterize the IR.

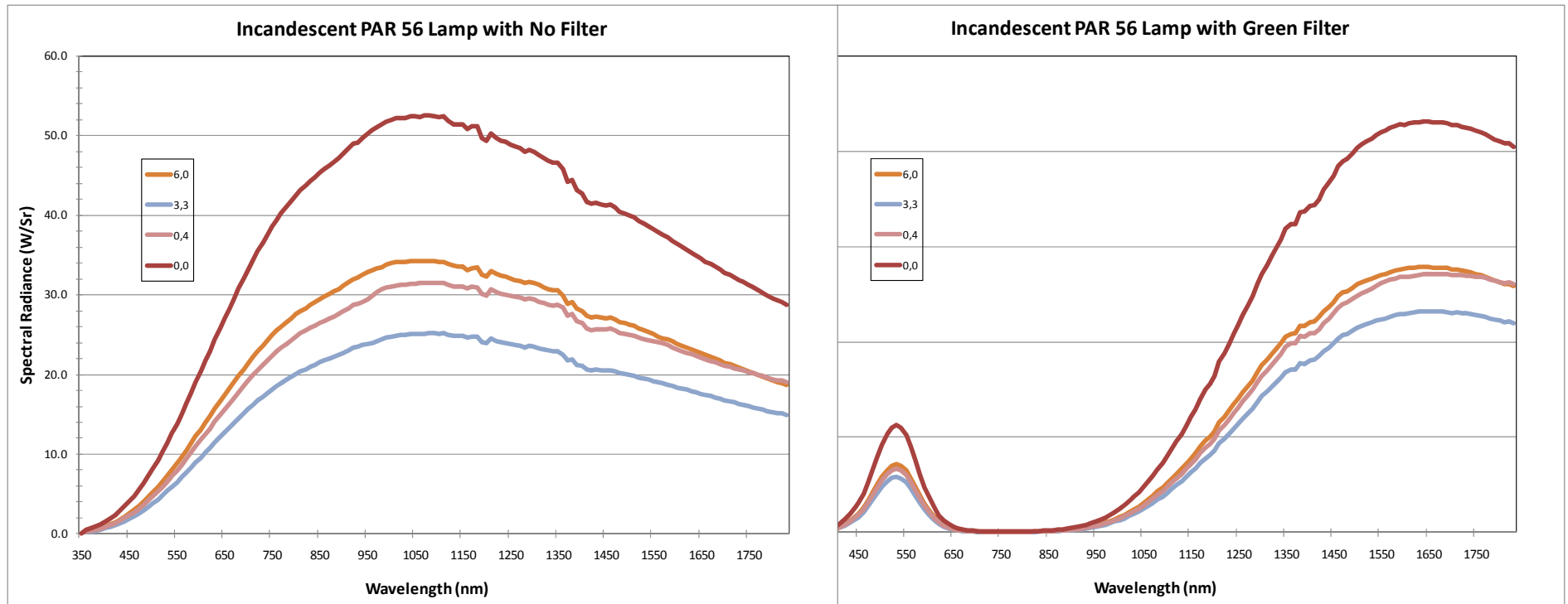- Current lamps
- New sources

Radio Spectrometer

- PROS
  - Calibrated method
  - Highly accurate optical radiation measurements
  - Repeatable process
  - Measures the IR in small wavelength sections
  - Defined measurement techniques
  - Defined calculations to Watts/Steridian
- CONS
  - Generally not very portable
  - Long measurement process
  - Cost

Radio Spectrometer IR data

Pyranometer

- Solar irradiance meter
  - PROS
    - Lower cost
    - Measures Irradiance on a surface
    - Portable for IR measurements
  - CONS
    - Calibration
    - Filtering
    - Broadband measurement
    - Intended for shortwave global solar radiation
    - Calculation from Irradiance to Radiance

Pyranometer

- Has been tried in confidence testing

- Several challenges addressed

- Filter 1350nm

- Calculations compared to the Radio Spectrometer

- More study and definition required

- Watts/meter conversion to Watts/Steridian by analysis

Filters to simulate Fog

- Fog chambers
  - Expensive
  - Limited access
  - Challenging for repeatable measurements
- Filters used in Confidence testing
  - Filters added until current lamp not detected by camera
  - Filters set to a level that passes some of the signature

Neutral Density Filters

optical density	% transmittance
0.0	100%
0.3	50%
0.6	25%
0.9	12.5%
1.2	6.25%
1.5	3.125%
2.7	0.195%
3.0	0.098%
3.9	0.012%

IR cameras

- NON Enhanced Flight Vision System camera systems
- Similar technologies to the EFVS
  - Cooled sensors/some uncooled
  - Used over a range of applications
- Data can be processed for measurement information
  - Response to the sources
  - Pixel counts
  - Contrast of the sources signature

IR cameras

- PROS
  - Lower cost that the EFVS
  - Portable
  - Repeatable measurements
- CONS
  - Not an EFVS
  - Not a calibrated process
  - Gain, aperture, and software processing determine picturs

Enhanced Flight Vision Systems

- Currently installed on over 1000 aircraft

- Approved for use in degraded flight conditions

- Systems have several key components
  - Window
  - Camera/sensor
  - Processor
  - Heads up Display

Enhanced Flight Vision systems

- Used in the confidence testing
- Sensors tied to a computer for data collection
- Filters used to adjust response
- Data collected and post processed for analysis

Recommendations going forward

- The Pyranometer method has merit
  - Need better defined process
  - Comparison tests to a Radio spectrometer needed.
- Filters to simulate Fog/clouds
  - Define filter selections to cloud state
  - Define the amount of transmittance.
- Watts/Steridian
  - Could we use a different specification to drive designs?
- Use of the EFVS/IR camera in qualification
  - How do you account for differences in performance?

Questions