



# Multispectral Illuminator (MSI)

PSYCH221 Final Project

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# Motivation



- **Multispectral imaging provides more information about objects than what the human eye can resolve**
  - Eyes have three cone types with significant overlap, no UV or IR
  - RGB imaging does not provide enough information to recreate actual spectra
  - Commonly used in medicine (Pulse Oximetry, lesion detection, etc) and geophysics (MGS, terrain mapping)
  
- **Multispectral imaging can be performed in various ways**
  - **Broadband light, sensors at individual wavelength bands**
    - Fastest to sample, most expensive and complex to build
    - Cannot determine fluorescence
  - **Narrowband light, sensors broadband or at multiple narrow bands**
    - Slower to sample (serial by wavelength), less expensive to build
    - Can determine fluorescence with latter option

***Existing illuminator / sensor capabilities in the lab are prohibitively slow for use on live (human) scenes***



# Existing Products



- **Existing Commercial products use only 3 colors**
  - Sufficient for direct viewing, night clubs, etc
  - Insufficient for imaging / reflectance viewing
  - **Color Kinetics, now owned by Philips, appears to be industry leader**
    - American DJ, Eliminator Lighting, MBT also produce LED Par Cans

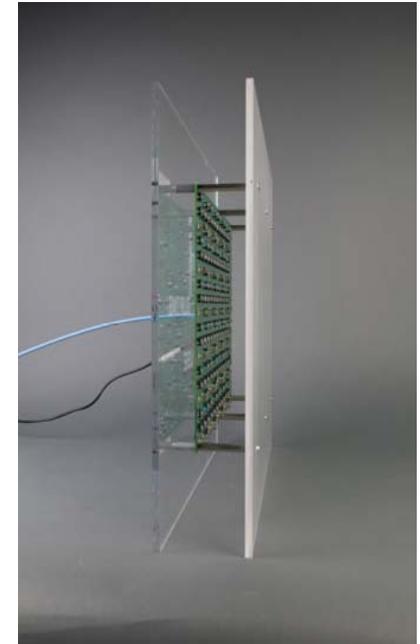


- **Lab setup is tungsten lamp plus filters/gels**
  - High intensity output
  - Must manually select color
    - Slow to take sequence of images
    - Many filters available
  - Produces significant amount of heat



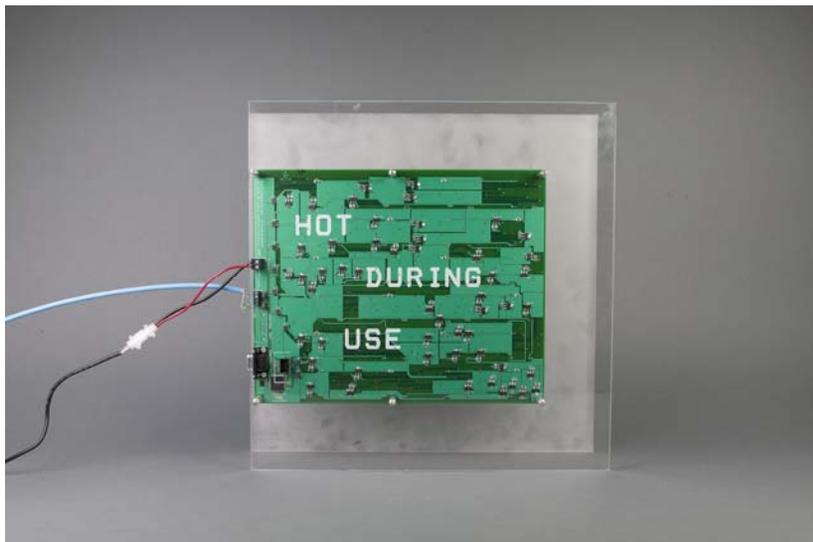
# Design Criteria

- **Multiple narrow-band spectral channels**
  - 6+ wavelengths required
  - Independently controllable
  - Pulse Width Modulation desirable, not necessary for imaging
  - Must use “inexpensive” COTS LEDs and components
    - 1W Luxeon LumiLEDs within budget
    - Metal core PCBs not within budget
  - Higher intensity is better
    - Should be maximized based on available components
  - Fast (~100ms or better) switching time between channels
    - Prevents registration blur between images
  - Illumination time of up to 30sec may be necessary
    - Photometric readings, etc
  
- **Camera Control / Coordination**
  - Lighting unit should be computer controlled to allow integration with dSLR controller software
  - Alternatively, lighting unit can directly control camera
    - Shutter speed, aperture control, etc not available with this option





# Design Features



- **8 wavelengths available**

- 430nm, 2x royal blue, cyan, green, amber, red, 880nm, 940nm
- 430nm LEDs extremely dim comparatively

- **24 clusters of each 9 LEDs**

- **Thermal Management**

- Copper pour on front for LED heat sinking
- LM75 thermal probe for automatic shutdown
- Copper pours on back for current regulator heat sinking

- **Microcontroller Based**

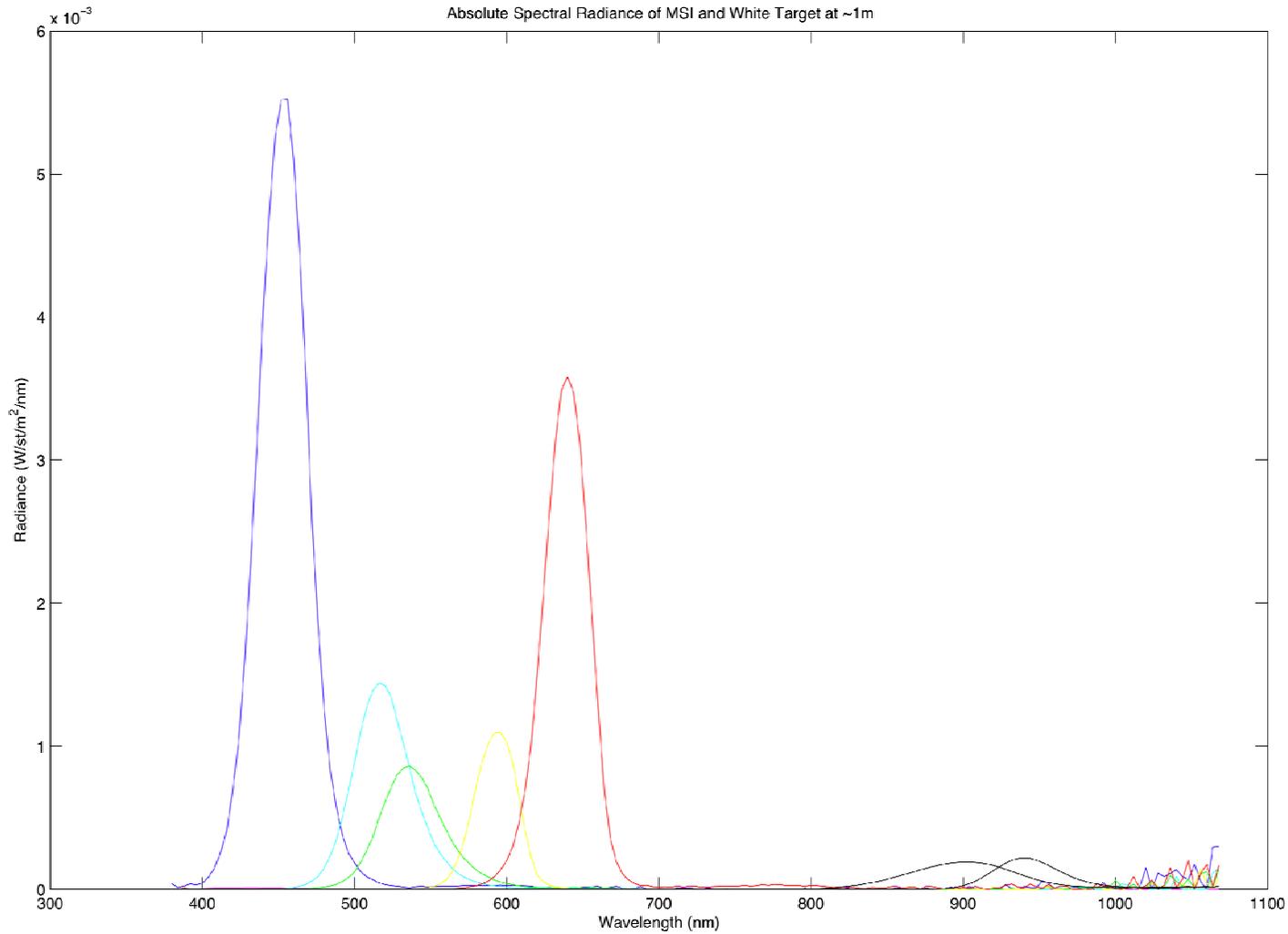
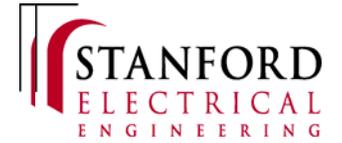
- RS232 control from PC
- Slave port for chaining multiple lights together
- Optically isolated camera focus and shutter control
- PWM available on all 9 channels

- **Misc Statistics**

- 4 copper layers, 7mil min trace/space
- 60W maximum allowable power consumption
- 30W nominal with one channel active

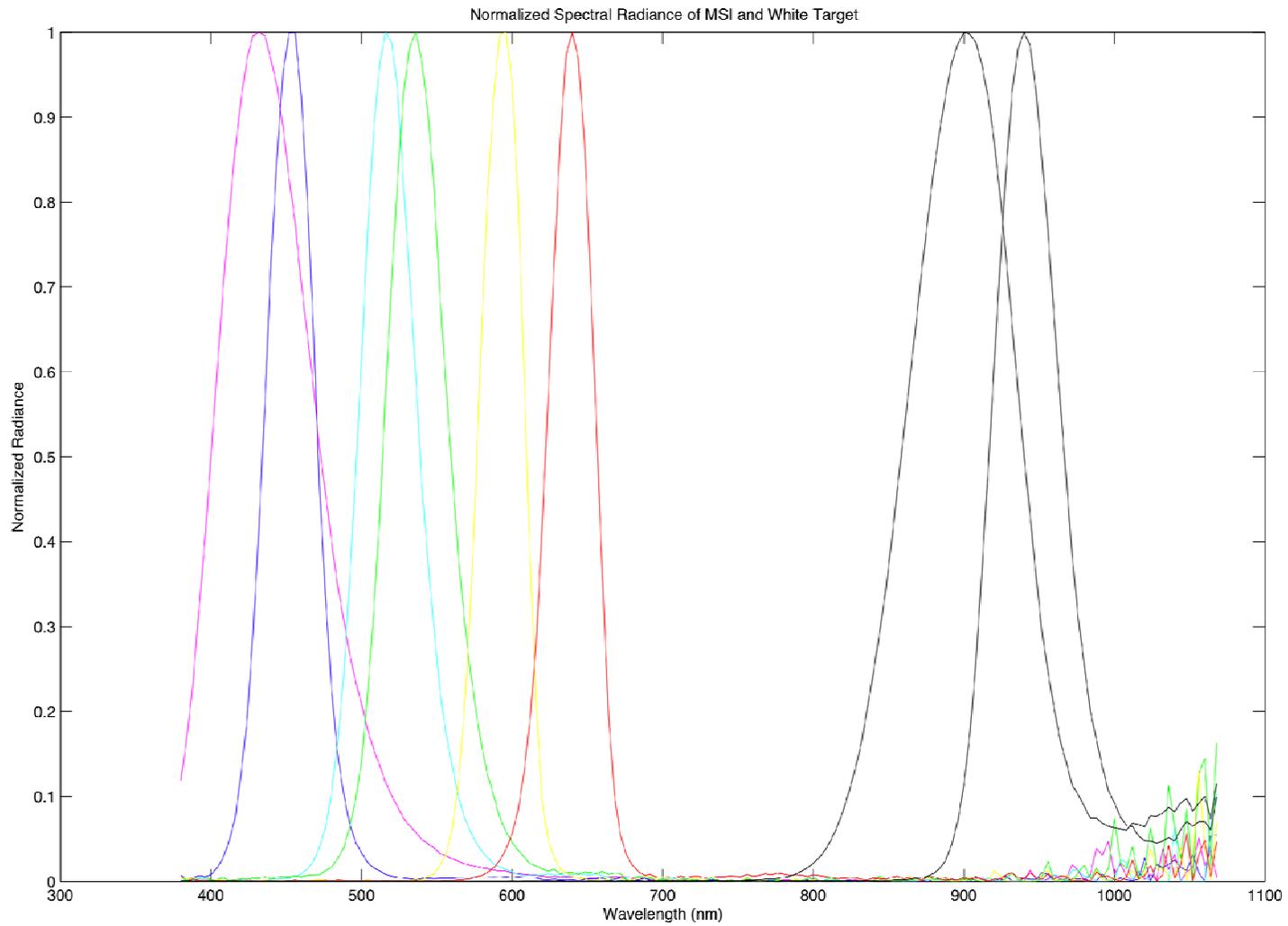


# Spectral Output, Absolute





# Spectral Output, Normalized





**Live Demo:**

**Multispectral Illuminator With  
Automatic Camera Control**