**Background**

- All materials above absolute zero emit thermal radiation.
- Objects with temperatures near or above room temperature (~300K) have peak emission at 7 μm-14 μm wavelengths.
- A Blackbody is an object that emits a broadband of thermal radiation defined by Planck's Blackbody Radiation Law.
- A graybody is an object that emits light with the same spectral shape, but scaled to lower powers by a factor called the emissivity.

**Approach**

Desired function of our filters

- Divide camera imaging range (7 μm-14 μm) into four equal energy/frequency bands
- Transmit one of four bands while reflecting the other three.
- Design material specific filters to only transmit where select materials are highly absorptive.

**Distributed Bragg Reflector (DBR)**

- A DBR is a spectrally selective, highly reflective optical structure
- Each interface partially reflects incident light resulting in constructive interference
- Tunability of reflection band limited by material choice and layer thicknesses

**Aperiodic Distributed Bragg Reflector (aDBR)**

- Aperiodic DBR designs allow for different thicknesses of the various materials
- With different thicknesses and material arrangements, the aDBR can reflect, transmit, and absorb at different wavelengths
- Great tunability in design!
- Designs are too complex for intuition

**Inverse Design Process**

- Written in Python with API TensorFlow
- Target spectrum chosen to match desired response
- aDBR structure is randomly initialized
- Reflection spectra of aDBR is calculated via Transfer Matrix Method [design spectrum] and compared to target spectrum
- Based on difference b/w them (error) structure is modified
- Repeat progress until set iterations

**Results**

- Each narrow-band filter enables the thermal camera to detect its own peak emitted power
- Employing each of these filters with the thermal camera will allow for spectrally selective imaging
  - More accurate temperatures
  - More accurate material identification

**Motivation**

Emitted Power Measurement Process

- Real materials don’t exactly follow Planck’s Blackbody Radiation Law
- Instead, material properties such as vibrations and conductivity change the IR absorption/emission properties
- Thus, lower emissivity and/or spectrally varying emissivity makes objects appear different temperatures than they are

**Current Status on Filter Growth**

- Due to backorder on substrates, filter growth had been delayed.
- Currently during the filter’s growth process, the surfaces start to become roughened/delaminated.
- Work is ongoing to reduce strain in the films.

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