Field Instrumentation Calibration Activities

- Laboratory Calibration
  - Spectral
    - Band center
    - Band passes
  - Spatial
    - Alignment
    - Field of View
  - Radiometric
    - Instrument
    - Reference Panel

Laboratory Spectral Calibration

- Filter Radiometers
  - Wide bandpass (>~10 nm)
    - Measured relative spectral response (monochromator with reference detector monitor)
    - Computed relative spectral response (measured filters, detectors, optics)
  - Narrow bandpass (<~10 nm)
    - Measured Filter transmission(match measurement to usage conditions)

Laboratory Spectral Calibration

- Spectroradiometers
  - Bandcenter, Bandwidth calibration with monochrometer (complete)
  - Bandcenter, bandwidth calibration with spectral line lamps -- Mercury, Argon, etc (selected wavelengths)

Laboratory Spatial Calibration

- Field of View mapping
  - Near Field (collimated light source)
  - Far Field (more difficult)
  - Alignment with pointing mechanism

Laboratory Radiometric Calibration

- Instrument
  - Linearity
  - Responsivity stability
    - With time, temperature, altitude
  - Bias stability
  - Absolute radiance/irradiance calibration
- Reference source
  - Panel BRDF
  - Panel directional hemispheric (correction to BRDF)

Absolute Radiometric Calibration

- Irradiance
  - Spectral irradiance lamps
    - Calibrated from 400 -2500 nm (cost inversely proportional to number of transfers from original standard)
    - Multiple lamps needed to track stability
- Radiance
  - Spectral irradiance lamp with calibrated spectralon panel (typically illuminated at 0° and viewed at ~45°)
    - Used by AVIRIS, Hyperion
    - Most suitable for small aperture instruments
    - More usable in atmospheric absorption windows
    - Stray light sensitive
    - Multiple lamps, comparison mechanism needed (could use ASD FR)
  - Integrating sphere (typically barium sulfate coated internally illuminated sphere)
    - Used by MODIS, ASTER, MISR, ETM+
    - Not inherently calibrated--typically need spectral irradiance source, diffuser and transfer radiometer to calibrate (could use ASD with spectralon panel)
    - Moisture sensitive particularly in longer wavelengths
    - Spectralon spheres becoming available from Labsphere-stability should be better and moisture problems should be less (at least a 30 cm diameter source is now available)

Laboratory Cross Calibrations

- BRDF round robins
- SIS round robins/validations

Field Calibration Activities

- Spectral
- Radiometric
- Spatial

Spectral Field Calibration

- Spectrometers
  - Line sources
  - Absorption features in dydimium, etc
  - atmospheric/solar lines
- Filter radiometers
  - Nothing readily available

Field Radiometric Calibrations

- Field portable sources
  - Stability checks-integrating spheres, lamps
  - Absolute calibration--field conditions generally not amenable to high accuracy calibrations
  - Cross calibration--different spectral character of integrating sphere versus sun requires good knowledge of device spectral response.
- Cross calibrations over reference panels

CSIRO Perceived Issues

- Calibration and usage of reference panels (400-13000 nm)
- Spectral calibration of spectroradiometers
- Environmental stability of instruments
- Characterization of field of view, particularly “cosine” response of diffusers
- Absolute irradiance and radiance calibration out to 2.5 micrometers

Possible strategies needing prioritization (1 of 2)

- Supply, usage and maintenance of diffuser panels (e.g., pristine reference panel annually calibrated, field diffusers referenced to pristine diffuser before and after field campaigns (size/fov/shading considerations--spectralon panels available up to 0.5 m on a side in one piece--larger panels can be assembled from multiple pieces)--also thermal region.
- Set of emission lamps for laboratory spectral calibration checks (Hg, Ar, Kr)--$200-$300/lamp plus $250 power supply ($US).
  - Tabulate usable peaks for each spectral range
- Set of field absorption standards (e.g, mylar,dydimium glass, holmium, etc)
- Stable light source for instrument stability testing (lamp/panel setup or small integrating sphere)
- Enviromental chamber testing of instrument stability (small environmental chambers ,e.g. Tenley are available, but hopefully someone elsewhere in CSIRO has one you can use/borrow)

Possible strategies needing prioritization (2 of 2)

- Field of view characterization
  - consider contracting out this effort (need collimator or point light source, black room, computer controlled translation/rotation stage)
  - Not frequent need to perform
- Absolute irradiance/radiance standards
  - Calibrated lamp for LICOR out to 2500 nanometers
    - Lamps can support this spectral range--check with LICOR about whether there are any other issues with LICOR 1800 and longer wavelengths
  - Spectralon panel with 1000 watt FEL lamp for spectral radiance source versus small integrating sphere