ODI Software Requirements & Scope

Requirement Hierarchy

- Safety of people.
- Safety of Facility & Instrument.
- Science Requirement Documents.
- Derived requirements.
- Operational considerations.
- Budget Constraints.

Science Requirements

- Defines the high-level science motivation.
  - Released Document.
  - Under version control of the WIYN Board.
  - Baseline metric to measure instrument success.

- Defines:
  - Observing cadences (speed, filter configurations).
  - OTA-specific modes (static, coherent, local....).
  - Sensitivity & Calibration.
  - Data quick look (quality assessment).

  - Off-site observing preparation (verify guide stars).
  - Low-level data reduction pipeline (bias, flat field, etc).

Scope of the Software (and Review)

1. Control of the instrument and archiving of the instrument status in a database.

2. Computer-assisted data acquisition in modes that utilize image motion compensation as enabled by OTA CCDs.

3. Observation planning, with emphasis on guide star selection and dithering.

4. Data quality assessment as defined in the Science Requirements Document.

5. An initial data reduction (“Tier I”) to remove basic instrument signatures.

ODI Operational Scenario - Baseline

- **Visiting Observer**
  - Verify guide star availability off-site before run. Create coordinate list.
  - Manually execute observations on-site.
  - Inspect data quality w/ quick-look tool.

  - Store raw data to exchangeable storage medium (USB-disk or equivalent). 1TB/night uncompressed.
  - Semi-automatically invoke on-site data pipeline. Create master calib files.
  - Store processed data to exchangeable storage medium (USB-disk or equivalent, 1-2 TB/night uncompressed.)

  - Total data volume: ~2-3TB/night uncompressed.
  - Support lossless data compression (gzip, cfitsio). CPU power available!

  - WIYN ingests raw data to NOAO archive (TSIP obligation).

Scope: Instrument Control & Monitor

- Filter Mechanism
  - Selection by User.
  - In/out & service position.

- Atmospheric Dispersion Compensator
  - Active/Neutral position.
  - Prism angle control, function of:
    telescope position, filter, atmospheric pressure, temperature.

- Dewar System
  - Vacuum Monitor.
  - Thermal control system & monitoring.

- Store complete instrument status in database, link to each data file.

Scope: Data Acquisition I

- Focal Plane readout.
  - Meta-data connection, header update, VO compliant.

- Active OTA modes:
  - static/coherent/local/targeted photometry/non-siderial tracking.

- Automatic guide star acquisition:
  - Manual from preimage (commissioning only).
  - Blind from short (1s) pre-image.
  - Semi-blind with catalog guide star prediction, from pre-image or on-the-fly.
  - Pre-determined from target list in pixel coordinates.

- Automatic fall-back when guide star acquisition fails:
  - Coherent guide mode when local mode guide mode fails.

Scope: Data Acquisition II

- Focus Sensor
  - Take exposures, find focus, adjust telescope focus.
  - Enable/disable control loop.

- Data handling:
  - Manual data storage by observer.
  - Ingestion of data into NOAO archive by WIYN.

Scope: Observation Preparation:

- Verify guide star availability off-site:
  - Check pointing for guide star availability in broad band filters.
  - Extrapolate fluxes for narrow band filters (zero-point adjustment).
  - Create dither patterns with verified guide star availability.

- Exposure time calculator.
  - Not formally required.
  - Ported existing exposure time calculator from SALT.

Scope: Data Quality Assessment.

- Down-sampled 1°x1° overview image.
  - Click on single detector image to enlarge, load in ***saoimage***.
  - Analyse single-chip data w/ iraf or equivalent.

- Future additions (Not part of this review):
  - Maps of background level, overscan noise, seeing.
  - Automatic quality check.
  - Data wall, pan through entire image.

Scope: Tier I Pipeline

- Basic linear instrument signature removal.
  - Overscan, Crosstalk, Bias, Dark, Flat.
  - Convolve flat field with shift history.
  - World Coordinate System update to ~0.3” rms.
  - *The easy stuff*.
  - Intended for science.

- Image stacking of 2x2 detector region (QUOTA)
  - Integer pixel shift only.
  - Purpose is depth estimation of dither sequence.
  - *Not* intended for science.

Expanded Operational Scenario

- Science-grade data pipeline:
  - Image stacking.
  - Object catalogues, <1% photometry, PSF characterisation, variable sky.
  - Service data reduction for astronomers, visitor center, remote login.
  - “Data Reduction & Distribution Center”.

- Queue-observing:
  - Completely define observing runs / surveys off-site.
  - Observations done by dedicated staff.
  - Ranking, matched with observing conditions.
  - Standard calibration plan, long-term monitoring of instrument.
  - Observations pipeline reduced by data center team.

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NOT SUBJECT OF THIS REVIEW

But:

Is ODI’s Software Design expandable?

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Scope: Summary

- Scope of ODI software intentionally limited.
  - Support basic visitor mode operations.
  - Have an end in sight.

- Have expandability in mind for ODI software architecture.
  - Allow innovative use of of OTA detectors.
  - Advanced operational modes would plan (and pay!) for software upgrades.