Database and Scheduling
Overview

Telescope Operations:
Scheduling
Accounting

MySQL database

project table  object table  obs table
MySQL Database

- Open-source database management software
- Organizes data into tables
- Complex searches are easily executed using simple MySQL syntax

- Interfaces available from Python, PHP, etc…
Basic Tasks

• Create an observing schedule:
  • Starting from evening twilight
  • Starting from some specific time
  • Do so rapidly (< minutes)

• Keep record of past observations:
  • Account for total time spent on object
  • Account for total time spent on project
  • Record when observations were made
PAIRITEL Database

- Main database comprised of 3 tables

- **project** table:
  - PIs of project, allotted observing time, completed observations

- **object** table:
  - Objects belonging to each project
  - RA, DEC, relative priority, record of recent observation

- **obs** table:
  - Requested observations of each object
  - Integration time, observation parameters, reduction parameters

- Simple, web-based interface to the database and its tables
<table>
<thead>
<tr>
<th>ObsID</th>
<th>ObjID</th>
<th>ProjID</th>
<th>IsActive</th>
<th>IsDone</th>
<th>Name</th>
<th>ExpTime_req</th>
<th>Exp_Start</th>
<th>Exp_Stop</th>
<th>worst_air</th>
<th>worst Seeing</th>
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Total number of records 58, displayed on 3 pages of 20 records per page.

<table>
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<th>Name</th>
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<th>percent_complete</th>
<th>total_hours_complete</th>
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</table>
Types of Observations

- Individual observation
- “Chained” observations:
  - single observation about every X hours
- ToO observation:
  - interrupt current observation
- For all observations:
  - size of region covered by dither
  - total integration time
  - highest acceptable airmass
- Observations assigned unique identifier: Project.Object.Observation
Altering Database

• Object and observations may be added to the database by users:
  • web-based interface to MySQL database
  • web-forms that use PHP and Python to interface with database
  • single or “chained” observations may be added

• Special ToO ability:
  • ToO observations may be added from command line
  • designed to force interrupt of current observation
  • plans observations for remainder of night
  • “go” to first image < 3 minutes
Telescope-Database Communications

• Telescope software regularly interfaces with MySQL database:
  • Python-MySQL capabilities
  • Gathers information for planning observations
  • Updates database after completing an observation
• Information passed between database software and observing software
  • XML files contain observation parameters
  • XML files contain output of camera during observation
<Observation>
  <database-ID>BD.3.5</database-ID>
  <RA>06:52:30.72</RA>
  <DEC>47:10:34.68</DEC>
  <LATEST-END>2005-04-16-21:11:04</LATEST-END>
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    <DKTYPE>self</DKTYPE>
    <photometer>no</photometer>
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Scheduling

• Software attempts to optimize entire night’s observations:
  • Schedule begins at twilight or specific time, runs until morning
• Software gathers available observations from the obs database
• Attempts to optimize over a set of parameters
• Writes XML file for each planned observation
• Software handles passing of XML files between scheduler and camera
Import all observations from database

Is Observation Complete?
Is Object Active?

Air Mass < Worst Air Mass before morning?
Within Telescope (HA, ALT) constraints before morning?

Observable Objects
While $T < T_{\text{End}}$:

A. Difference between current and best airmass for night?

B. Priority

C. Distance from current position?

D. Time since observation of previous object in "chain"?

E. Already scheduled in current scheduling run?

Min[$F(A,B,C,D,E)$]

Write XML file for obs

$T = T + \text{Exp\_Time} + \text{Overhead}$
• Implemented using all Python
• Typically takes <2 minutes with 60 objects and 1000 observations
• Schedule can be made via web at sked.pairitel.org
  • minor changes to the schedule can also be made
PAIRITEL Status at 2005-04-16 21:02:25.47 UT

PAIRITEL Schedule Viewer

Current Date: 04-16-2005 Local
Current Time: 14:01:26 Local

Last Scheduled: 04-16-2005 14:01:26 Local
Current Julian Date: 2453477.376

Evening Twilight UT: 02:28:00
Morning Twilight UT: 12:19:14

Information Bar. Click on object above to see details and change the user priority.
Post-Observation

• Output XML file from camera is parsed
• Database is updated to reflect completed observation
• Next observation begins
  • next XML observation file written by scheduler is begun
Future

• Implementation of UT specific observations
• More efficient use of MySQL syntax to expedite scheduling
• Improvements to optimization scheme in scheduler