



The MACRO Consortium



Robotic Telescope Software Development with the MACRO Consortium's *Robert L. Mutel Telescope*: **Pyscope**

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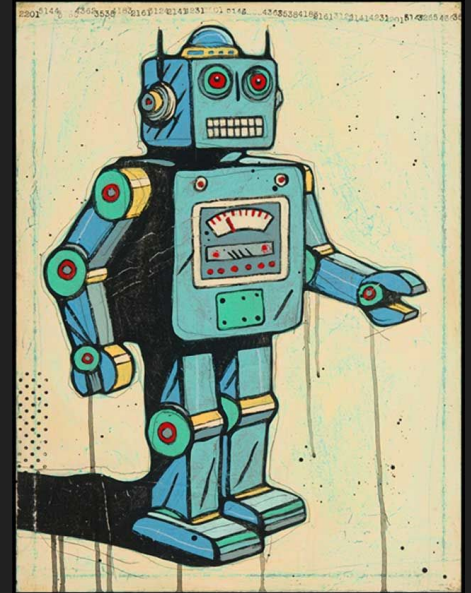
IOWA





Why should I roboticize my university telescope?

- Who doesn't love sleep?
- (Half-)meter telescopes provide flexibility that is otherwise unavailable
- Some research programs are impossible on competitively allocated facilities
- Efficient time use via dynamic queues
- More student engagement and project ownership
- Unique instrumentation development opportunities



*Robots Have Anxiety Too –
Joel Ganuchau*



The Precursors: Talon & IOTA

- Talon was written in C by Elwood Downey
- Systematics drove Robert Mutel to move telescope to Winer Observatory, necessitating remote operations
- After several telescope iterations, the IOTA code was developed by Kevin Ivarsen (now head of software at PlaneWave)
- Iowa Observatory Telescope Automation (IOTA) was Python-based but not generalized
- The transition from the Gemini system operated by the University of Iowa to RLMT operated by MACRO provoked a complete rewrite of telescope software





Introducing pyscope

Three goals:

1. Unify robotic telescope operation under a common and consistent Python-based API that is familiar to astronomers already
2. Does not require special setup and can operate in parallel with remote/manual operations
3. Provides rapid setup and operation of autonomous data collection to support a wide variety of experimental designs





Package Architecture

Three Main Modules:

1. Observatory
 - a. Creates and enforces a consistent API for driver communication
 - b. `observatory` class
2. Telrun
 - a. Uses the Observatory module to provide automated data collection
 - b. `schedtel` and `TelrunOperator`
3. Reduction
 - a. Basic functions and wrappers for near-immediate science-ready data products for student lab use
 - b. `ccd-calib`, `calc-zmag`, `astrometry-net-wcs`



Adding on to pyscope: What will YOU do?

The common API allows users to develop tools to interface with pyscope methods.

Example: the scheduling submission form on the MACRO webpage

The screenshot shows the MACRO website's scheduling submission form. At the top, there is a navigation bar with links for Home, About us, Images, Blog, Contact, Observations, DONATE, AASPrep, and a search icon. Below the navigation bar is a 'Project Title' input field. The main form is divided into three columns: 'Target', 'Filter/Exposure', and 'Advanced Options'. The 'Target' column contains three rows, each with an 'Object' input field, a 'Non-Sidereal' checkbox, and a checked 'Use Catalog Position' checkbox. The 'Filter/Exposure' column contains three rows, each with a 'Filter' dropdown menu set to 'L (Luminance [AstroDon Gen 2])', an 'Exposure Time' dropdown set to '0.125 Seconds', and an 'Imaging Mode' dropdown set to 'High Gain'. The 'Advanced Options' column is currently empty. At the bottom of the form, there are links for 'Add Row' and 'Delete Checked Row(s)', a 'Submit' button, and a small square button with an upward arrow.



Documentation is on the way!

The screenshot shows the pyscope documentation page. At the top left is the pyscope logo. The navigation bar includes links for Installation, User Guide, API Reference, Development, Citing pyscope, and More. A search bar is on the right. A notification box at the top center reads: "This is the latest development version. Some features may not yet be available in the published stable version. Read the [stable version of this documentation](#)." Below the notification is the main heading "Telescope Control with Python". A metadata bar shows license (AGPLv3), DOI (10.5281/zenodo.8403570), pypi version (v0.1.6), python versions (3.10 | 3.11 | 3.12), downloads (58/month), and powered by AstroPy. A "Donate to pyscope" button is also present. The main text starts with "pyscope is a pure-Python package for robotic scheduling, operation, and control of small optical telescopes." An "Important" section follows, stating: "If you use pyscope for data collection or work presented in a publication or talk, please help the project by properly acknowledging or citing the package." Further text describes pyscope as an open-source project for astronomical instrumentation, built on the ASCOM standard, and mentions the telrun module. At the bottom right, there are buttons for "Read the Docs" and "latest".

<https://pyscope.readthedocs.io/en/latest/>





Our GitHub page: Get updates

The screenshot shows the GitHub repository page for `macro-consortium/pyscope`. The repository is public and has 10 forks, 5 watchers, and 9 stars. The main branch is `main`, with 5 other branches and 7 tags. A recent pull request by WWGolay is merged. The repository contains several files and folders, including `.devcontainer`, `.github`, `._tba`, `conda`, `docs`, `my_test`, `pyscope`, `tests`, `.gitignore`, and `.pre-commit-config.yaml`. The `About` section describes `pyscope` as a pure-Python package for control of small robotic telescopes, with links to `pyscope.readthedocs.io` and various tags like `python`, `automation`, `astronomy`, `ascom`, `astropy`, and `observatory`.

File/Folder	Description	Time
<code>.devcontainer</code>	Close #102	7 months ago
<code>.github</code>	Update dependabot.yml	last week
<code>._tba</code>	Fix requirements and various versioning issues	2 months ago
<code>conda</code>	Update conda meta.yaml	10 months ago
<code>docs</code>	Merge branch 'main' into winer-dev	2 months ago
<code>my_test</code>	Re-run black formatting, pre-commit hooks, etc...	2 months ago
<code>pyscope</code>	Fix sim server	2 months ago
<code>tests</code>	Re-run black formatting, pre-commit hooks, etc...	2 months ago
<code>.gitignore</code>	Add init_telrun_dir and test	4 months ago
<code>.pre-commit-config.yaml</code>	Fix pre-commit settings	2 months ago

<https://github.com/macro-consortium/pyscope>





Our GitHub page: Contribute

The screenshot shows the GitHub repository page for 'pyscope'. At the top, there are navigation links for 'README', 'Code of conduct', 'AGPL-3.0 license', and 'Security'. The repository name 'pyscope' is prominently displayed. Below the name, there are several badges: 'license AGPLv3', 'DOI 10.5281/zenodo.8403570', 'pypi v0.1.6', 'python 3.10 | 3.11 | 3.12', and 'downloads 58/month'. Other badges include 'powered by AstroPy', 'codecov 0%', 'docs passing', 'Codespaces Prebuilds passing', 'pre-commit enabled', 'code style black', 'imports isort', and 'Donate to pyscope'. The main content area features the 'pyscope' logo, which consists of an orange telescope icon and the text 'pyscope' in a large, white, sans-serif font. Below the logo, the tagline 'Complete Observatory Control' is written in a smaller white font. A paragraph of text describes the repository as a pure-Python package for robotic scheduling, operation, and control of small optical telescopes. It also mentions that 'pyscope' is an open-source project built on top of the ASCOM standard, with support for non-ASCOM devices and third-party applications like MaxIm DL.

<https://github.com/macro-consortium/pyscope>





pyscope

Complete Observatory Control

Thank You!

Questions?

