Guide for using
ASTAP Solver For AstroImageJ

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Contents

1. Introduction

ASTAP (**A**strometric **STA**cking) is a software application for astrometry or plate solving fits format images. It is integrated into several astronomy automation packages, including SGP (Sequence Generator Pro), Voyager, NINA and others. This document covers "ASTAP_for_AstroImageJ" (astap.jar), java software to run ASTAP from the Plugin menu in the AstroImageJ toolbar (AIJ version 5.0 or later). These instructions assume the user is already familiar with AstroImageJ.

Astap.jar runs ASTAP from the command line; command line options are detailed in the ASTAP link below. While the current astap.jar version is Windows only, extending astap.jar to Linux is possible.

Astap.jar can be downloaded from its GitHub repository. The two java applications to download are:

astro_plugins-1.0x.jar   compiled as an ImageJ plugin to link astap.jar to AIJ plugins menu options.

astap.jar   compiled as a standalone java exe

Refer to the GitHub README for more software details.

Refer to section 2 for software install instructions. Please note that astap.jar looks for ASTAP and java in specific paths, listed in this section.

Section 3 is an introduction to the user interface controls and running astap.jar with example files. The example fits files can be downloaded from the GitHub repository.

Section 4 covers running astap.jar with the WASP-12b example fits files, which can be downloaded from the AIJ website.

Section 5 contains a short table comparing ASTAP with ANSVR, where ANSVR is the local plate solver integrated into AstroImageJ.

Section 6 contains a brief summary; this section also describes potential solutions where the plate solving process fails.

License

Astap.jar is licensed under GPL-3.0

2. Install Software

2.1. Install AstroImageJ

Link to AstroImageJ installation packages:
https://www.astro.louisville.edu/software/astroimagej/installation_packages/.

If not already installed, download AstroImageJ 5.x windows x64 java18

Index of /software/astroimagej/installation_packages

Name	Last modified	Size	Description
Parent Directory		-	
AstroImageJ_installation_linux.html	2022-06-16 01:39	5.7K	
AstroImageJ_installation_mac.html	2022-01-05 03:40	59K	
AstroImageJ_installation_windows.html	2014-12-07 01:23	54K	
AstroImageJ_script.tar.gz	2022-06-16 01:08	1.0K	
AstroImageJ_v5.1.0.00_linux_x64_java18.tar.gz	2022-07-04 04:48	117M	
AstroImageJ_v5.1.0.00_mac_intel_java18.dmg	2022-07-25 20:43	75M	
AstroImageJ_v5.1.0.00_windows_x64_java18.zip	2022-07-04 04:36	108M	
Older_versions/	2022-07-26 13:51	-	
Xresources	2014-12-07 17:49	412	

Apache Server at www.astro.louisville.edu Port 443

To follow the instructions in this guide, copy and rename the uncompressed AstroImageJ folder to:

 C:\Astro\AstroImageJ 5

To update AstroImageJ to the latest version, open AIJ and from the toolbar, select Help => Update AstroImageJ .., then in the Updater dialog select the latest version from the Upgrade drop down (5.1.2 at time of writing)

Option: Section 4 covers batch solving with WASP-12b example images. Download and copy the uncalibrated example images to folder: .\AstroImageJ 5\wasp12:

https://www.astro.louisville.edu/software/astroimagej/examples/.

Index of /software/astroimagej/examples

Name	Last modified	Size	Description
Parent Directory		-	
README	2017-02-20 19:02	1.3K	
WASP-12b_example_calibrated_images.tar.gz	2015-06-09 02:52	4.3G	
WASP-12b_example_calibrated_images.zip	2015-02-19 00:04	4.4G	
WASP-12b_example_raw_biases.tar.gz	2017-02-20 18:12	133M	
WASP-12b_example_raw_biases.zip	2017-02-20 07:02	136M	
WASP-12b_example_raw_darks.tar.gz	2017-02-20 18:14	135M	
WASP-12b_example_raw_darks.zip	2017-02-20 07:05	138M	
WASP-12b_example_raw_flats.tar.gz	2017-02-20 18:13	265M	
WASP-12b_example_raw_flats.zip	2017-02-20 06:57	266M	
WASP-12b_example_uncalibrated_images.tar.gz	2017-02-20 18:35	4.3G	
WASP-12b_example_uncalibrated_images.zip	2017-02-20 07:01	4.4G	
standard_transit.plotcfg	2016-03-05 02:49	132K	

2.2. Install ASTAP solver

Link to ASTAP download installers (SourceForge): http://www.hnsky.org/astap.htm.

Download the Program installer for your operating system (e.g. Windows 64 bit).

Run installer, in Windows *accept the default folder* C:\Program Files\astap.

Download the Large star database H18 (down load size is about 1GB), run the setup app and select the default folder (C:\Program Files\astap).

To confirm installation, click on shortcut to open the Astrometric Stacking Program and fits viewer (ASTAP), then close this window.

2.3. Install AstroImageJ plugin

Link to GitHub online repository https://github.com/richardflee/astap_solver_for_astroimagej.

Follow instructions in README.md to download application jars and test fits files.

Navigate to AstroImageJ plugins folder and copy astap.jar in the plugins folder

Make a new sub-folder: \AstroImageJ 5\plugins\Astro Apps and copy astro_plugins-1.0x.jar into this folder (x is program version in range a to z)

2.4. List of Installed software

	Folder or File	Path	Notes
1	ASTAP.exe	**C:\Program Files\astap**	Default install path,
2	H18 database	**C:\Program Files\astap**	Same folder as exe
3	AstroImageJ	C:\Astro\AstroImageJ 5	Path referred to in instructions
4	astap.jar	**.\AstroImageJ 5\plugins**	AIJ plugins sub-folder
5	astro_plugins-1.0a.jar	**.\AstroImageJ 5\plugins\Astro Apps**	User creates sub-folder
6	Java install	**.\AstroImageJ 5\jre\bin**	Java 18 or later

Bold path indicates absolute or relative paths for astap.jar to find the required software.

2.5. Confirm software install

Run AstroImageJ and from toolbar select Plugins => Astro Apps => Run ASTAP App. The Run ASTAP Astrometric Solver for AstroImageJ dialog should open with default settings (see below). If the dialog fails to open, please check paths to software items 3, 4, 5 and 6 are in the installed software table. Click on the Close icon to close the dialog.

2.6. List of test fits files

To follow these instructions, create a new folder: \AstroImageJ 5\astap data, unzip and copy sample files into the astap data folder. The astap data and wasp example files are:

Fit Files	No.	Path	Notes
wasp104	3	C:\Astro\AstroImageJ 5\astap data	See section 3
wasp12b	230	C:\Astro\AstroImageJ 5\wasp12 data	See section 4

3. Introduction to running ASTAP Solver

3.1. Astap for AstroImageJ dialog:

Run AstroImageJ and from toolbar select Plugins => Astro Apps => Run ASTAP App (ignore other app options).

The ASTAP for AstroImageJ dialog opens with AstroImageJ folder selected. Click the [Select Folder] Button, select and open astap data folder from the Open FITS Folder dialog.
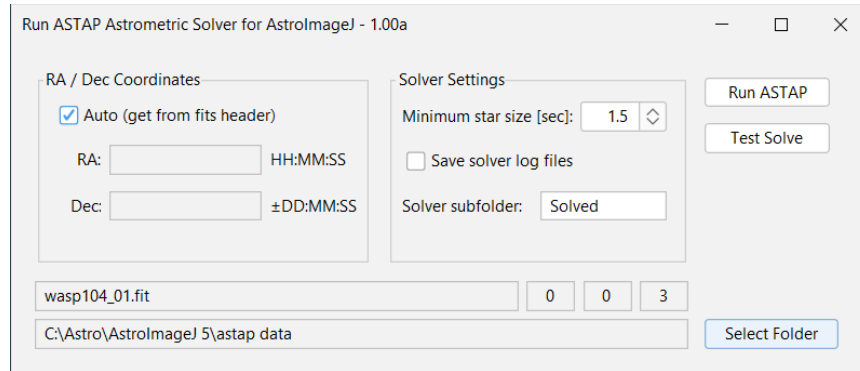
The screenshot shows default settings, sufficient to solve fits images in many cases. Tool-tips identify the unlabelled controls.

Button controls:

Run ASTAP – applies the astap plate solver to every fit, fits and fts file found in selected folder

Test Solve – applies astap solver to a single fits file to verify solver settings

Select Folder – opens the Open FITS Folder dialog

RA / Dec Coordinates

Auto (get from fits header) –

Checked (default): astap reads image centre coordinates from header file

Unchecked: enables RA and Dec text fields for user entry (sexagesimal format)

Solver Settings:

Minimum star size (sec): minimum size of object before treated as a star for plate solving. Values range from 0.5 to 4.0 (arcsec).

Note: Try different settings in conjunction with Test Solve function to get a working setting.

Save solver log files –

Checked: saves log file with each solved fits file and can be useful if plate solve fails.

Unchecked (default): No log file saved; software reverts to this state after each run.

Solver subfolder: Solved fits files are copied to this folder (C:\Astro\AstroImageJ 5\Solved. Option for user to rename this folder, e.g. Solved Files

Fits files failing plate solve are copied to SOLVE_FAILED folder:

 C:\Astro\AstroImageJ 5\Solved\SOLVE_FAILED.

Textbox controls

The textbox left of Select Folder button contains the fits folder path.

The long box above contains the processed fits file.

The set of three smaller text boxes are solver PASS, FAIL and TOTAL counters.

3.2. Run astap for AstroImageJ with test data

Click [Select Folder], in the Open FITS dialog, select the astap data folder and click Open to import test fits files. The ASTAP dialog updates with selected folder path and TOTAL count = 3 (fits files counter).

Click [Run ASTAP] to start solver sequence. When the run finishes, the next screenshot shows that two fits files were successfully solved with one failure (2 | 1 |3).
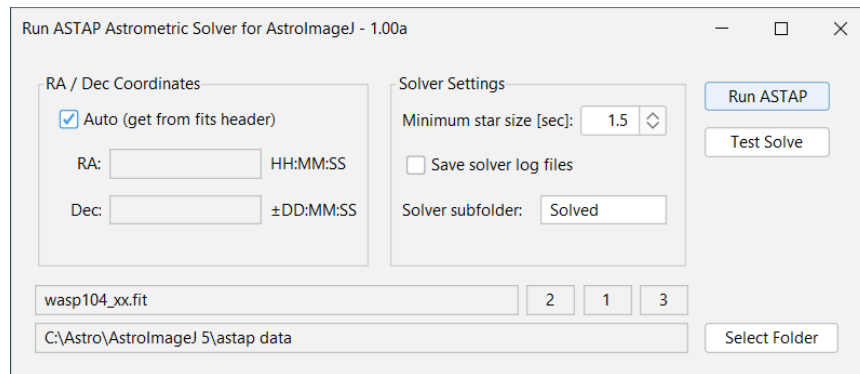
3.3. Example files ASTAP Solver fail

Click [Select Folder], navigate to and open SOLVER_FAILED folder: C:\Astro\AstroImageJ 5\astap data\Solved\SOLVE_FAILED. The dialog updates to 0 | 0 | 1 (one untested file).

The figures below compares images of plate solve fail (wasp104_xx.fit) with one of the other files in the AIJ viewer. The images appear to be of similar quality but with wasp104_xx.fit image rotated 180° ("post-flip") relative to wasp104_01. ASTAP plate solving is independent of image orientation and image rotation does prevent ASTAP reaching a solution. The wasp images are raw unprocessed image files, so perhaps plate solving failed due to excess hot pixels.

In the astap dialog, increase Minimum star size from 1.5 to 2.0 and click [Run ASTAP] to run the solver on wasp104_xx.fit in the SOLVE_FAILED folder. This time ASTAP should find a solution: 1 | 0 | 1.

Click [Select Folder], navigate back to and open the astap data folder, increase size setting from 1.5 to 2.0 and re-run ASTAP solver. This time all three fits files should be successfully plate solved 3 | 0 | 3.

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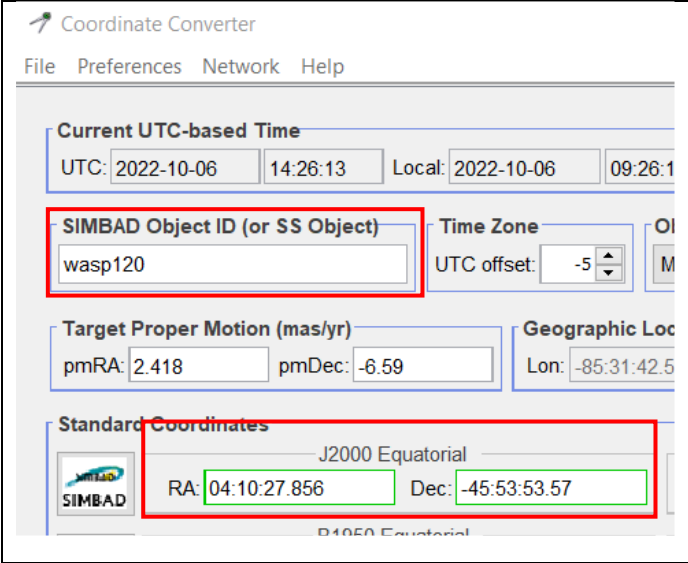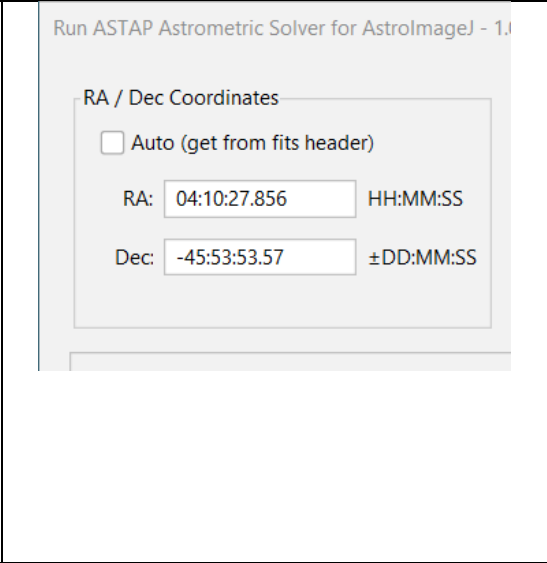|	
WASP104_01.FIT: Solved with default settings. Pre-flip	WASP104_xx.FIT: Solve failed with default settings. Post flip (inverted)
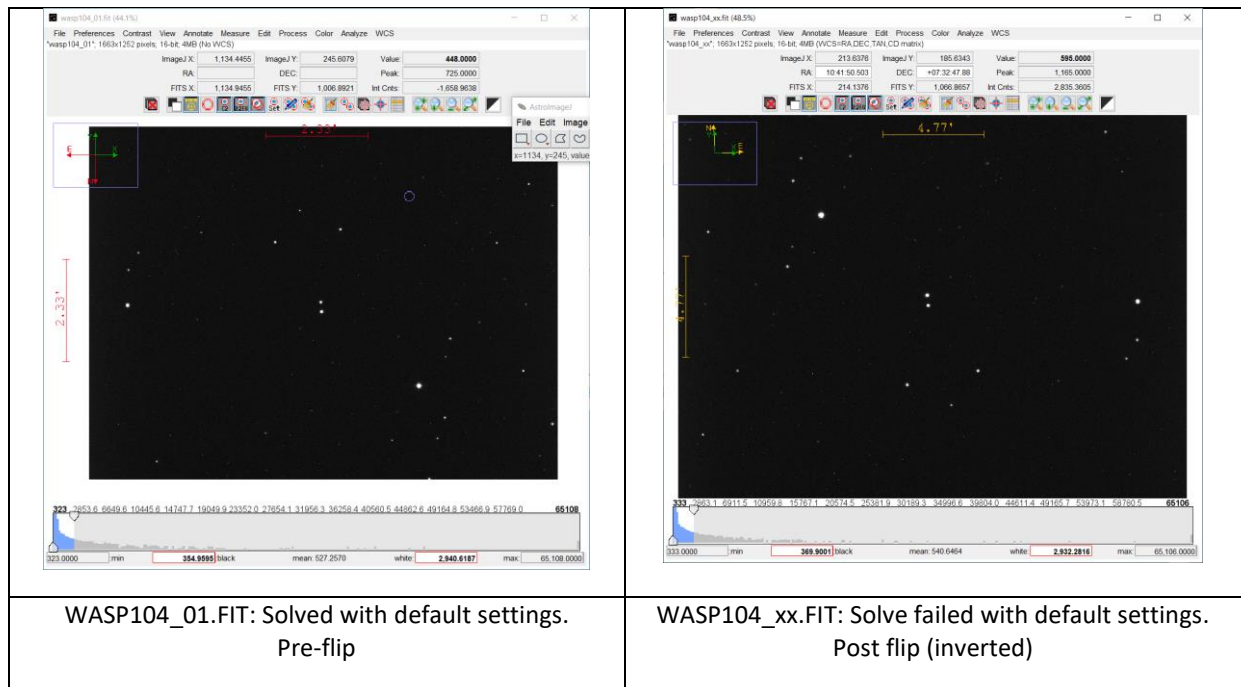
4. Batch solve a set of WASP12 fits files

Demonstrates using plugin with user input coordinates on large data sets – refer section 2 for details on downloading the wasp example files.

Open the ASTAP solver plugin (AIJ Toolbar => Plugins => Astro Apps => Run Astap App), click [Select Folder], navigate to and open the wasp12 data folder. Confirm counts text boxes read 0 | 0 | 230.

To demonstrate entering coordinates by hand, uncheck Auto control to enable the RA and Dec text boxes.
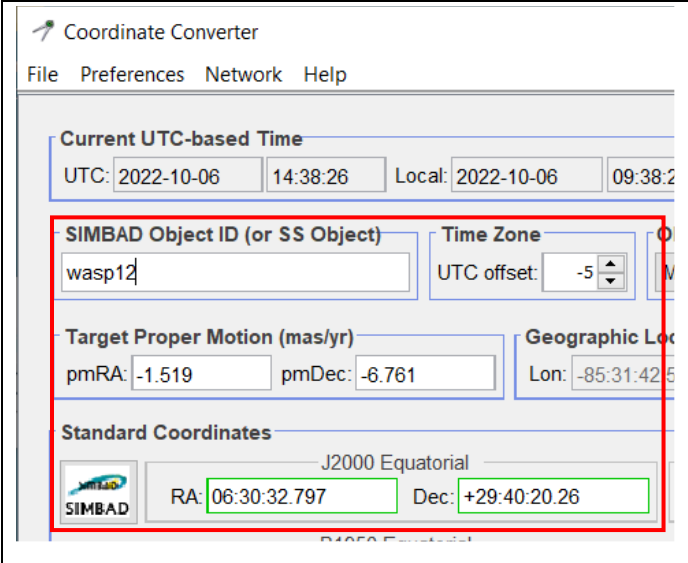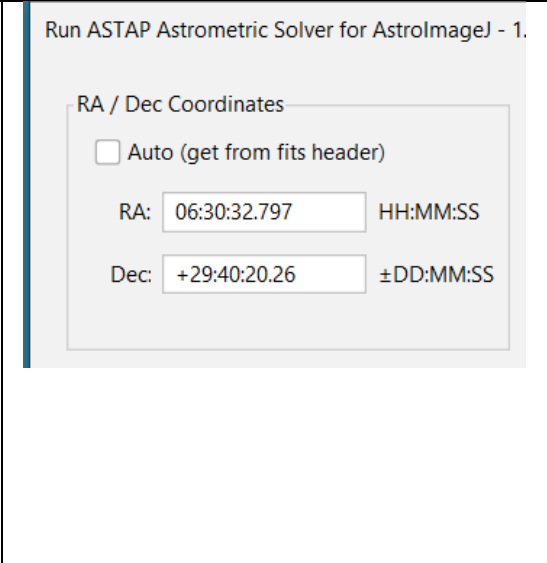
In the AIJ Toolbar, click on the Coordinate Converter Tool (second icon from the right), to open the Coordinate Converter dialog. Ignoinge for now the deliberate error … enter *wasp120* in the SIMBAD Object ID field, and press <Enter> to query the SIMBAD database.

Coordinate Converter, SIMBAD Object ID wasp120	Wasp120 coordinates copied to solver dialog

Copy / paste the J2000 RA and Dec coordinates from the CC dialog into the corresponding fields in the ASTAP dialog.

Click [Test Solve] to run ASTAP solver on a single file. As the specified coordinates for wasp120 are more than 10° away from the correct coordinates, ASTAP fails to find a solution (0 | 1 | 230). Running a Test Solve is a quick check on solver settings.

Correcting our target name typo - edit the SIMBAD field to **wasp12**, run SIMBAD search in the CC dialog, then overwrite the ASTAP dialog coordinates with the updated wasp12 coordinates.

Coordinate Converter, SIMBAD Object ID wasp12	Wasp12 coordinates copied to solver dialog

Running a Test Solve should now pass (1 | 0 | 230).

Click [Run ASTAP] to start batch processing, which will take several minutes depending on processor speed. While solver is running, the [Start ASTAP button] toggles to [Stop ASTAP]

Clicking [Stop ASTAP] aborts the running solver sequence and the button text toggles back to [Run ASTAP].

Note: After clicking [Stop ASTAP] then [Run ASTAP], the Solved folder is deleted and the solver sequence starts with the first fits file, e.g. 0 | 0 | 230 for wasp12.

5. Compare ASTAP with ANSVR Astrometric Solver Applications

Summary table comparing ASTAP with ANSVR plate solving software.

Parameter	ASTAP	ANSVR
Integration with AstroImageJ 5	Partial Integration [1]	Fully integration
Database disk space	1 Gb [2]	Up to 20GB [3]
Time to solve 200 test files (wasp104) (sec) [3]	100s ~ 0.5 s/image	1000s ~ 5s / image
Time to solve 230 wasp12b test files [3]	300s ~1.3s / image	1800s 7.8s / image
Run under Linux	TBC [4]	?? [5]

[1] Partial integration through astap for AstroImageJ plugin

[1] H18 large star database

[2] Approx. download size for FOV < 20 arcmin

[3] Approx timings, Intel nuc i7 processor

[4] Option to run ASTAP using Linux command line

[5] Possible option to run solve-field directly link

6. Summary

ASTAP is a popular option for plate solving fits image files. AIJ plugin astap.jar part integrates ASTAP with the latest versions of AstroImageJ.

Tests on WASP12 and other fits files confirm that the plate solving routines are fast and robust. Minimum star size is the only solver setting, normally set in the range 1.5 to 2.5. If available, ASTAP imports telescope pointing coordinates from the fits file header.

With full integration into AIJ, ASTAP would be a worthwhile alternative to ANSVR, especially where faster solve rates would be useful, and/or where disk space is at a premium.

ASTAP Plate Solver Checklist

Refer to the ASTAP guide for quick checklist for solving [link] .

1. The guide follows the ASTAP author's recommendation of plate solving unprocessed (raw) image files. Linear reduced images should also be good to solve, with less hot pixel noise to potentially degrade the solver process.

2. In test runs with unprocessed images, about 5 in 200 images consistently failed ASTAP plate solve with default settings. In this case, increasing Minimum star size from 1.5 to 2.0 or 2.5 corrected the issue.

3. Fit files which fail plate solve are quarantined in a SOLVE_FAILED folder. The user can try different star size settings on the quarantined set.

4. Checking the Save solver log files option will save log files in the Solved folder. Example log file extracts:

Wasp104_02.log: Solution found	15:58:44 61 stars, 52 quads selected in the image. 46 database stars, 39 database quads required for the square search field of 0.3°. Search window at 139% based on the number of quads. Step size at 100% of image height.
	15:58:44 16 of 16 quads selected matching within 0.007 tolerance. Solution["] x:=0.866393*x+ 0.034974*y+ -768.539261, y:=0.035140*x+ -0.866467*y+ 515.670874
	15:58:44 Solution found: 10: 42 24.0 +07° 26 09 Solved in 0.2 sec. Δ was 0.0". Mount Δα=-26.7", Δδ=-2.9". Used stars down to magnitude: 17.1
Wasp104_xx.log: No solution found	15:58:44 51 stars, 39 quads selected in the image. 38 database stars, 29 database quads required for the square search field of 0.3°. Search window at 160% based on the number of quads. Step size at 100% of image height.
	15:58:45 No solution found! :(

5. Should running ASTAP solver through astap.jar plugin continue to fail on good quality images, try plate solving these images with the ASTAP desktop app, which offers more solve settings, see link above.