What's New in Version 10
and
Why Should You Spend your Hard-earned Money to Get it

Revised 2009 December 7

Everyone knows that a good portion of a software company's revenue comes from upgrades. If you've purchased MPO Software, you also know that most upgrades, not just updates, have been free and that the original cost was low compared to many other products of a similar nature.

It's been three years since a "forced, paid" upgrade has been released. Given what's new in version 10 mean higher costs for materials, a paid upgrade seems eminently fair. However, I understand that you want more than my say so that version 10 warrants spending your money, no matter how modest the cost.

So, here's a list of the main new features in MPO software, with the most significant being to MPO Canopus, by far the most used of all the MPO programs.

Overall Changes

The MPOSC3 Catalog

Version 10 introduces the MPOSC3 catalog, which replaces the MPOSC, MPOSC2, and 2Mass files. The MPOSC3 is more than 2GB, requiring its own DVD. What makes it special?

The MPOSC3 is a hybrid of the 2MASS, Carlsberg, and Sloan Digital Sky Survey (SDSS) catalogs, containing nearly 300 million stars. For each star, BVRI magnitudes are available using the 2MASS to BVRI conversions that I developed (see *Minor Planet Bulletin* **34**, 113-119). If available, the SDSS g', r', and i' magnitudes are also included. The BVRI magnitudes have proven extremely useful in linking night-to-night sessions, providing on average agreement of nightly zero points to 0.03 mag or better.

A change in MPO Canopus allows you to use any of these magnitudes from all the stars in a field to derive an instrumental versus catalog offset, e.g., v-V, and apply that to the target that you're working to get a "true" magnitude that is generally accurate to < 0.05 mag. More on that later.

Getting Ready for APASS

The AAVSO (or Arne) Photometric All-Sky Survey will produce accurate BVgri magnitudes over the entire sky from 10-17 magnitude. Initial work has started and it's hoped to be done in three years. Many changes have been made to take advantage of this catalog when available. I've already been talking to Arne Henden about how to interface with the APASS on-line so that Canopus in particular, can access the data in real time as needed.

UCAC3 Support

MPO Software will be shipped with the UCAC3 dual-sided DVD provided by the USNO. I have about 100 copies kindly supplied by Dr. Zacharias. When those run out, I will find a way to make more.

The main benefit of the UCAC3 is that it covers the entire sky, not just up to +50° as did UCAC2. There have been numerous discussions about problems with UCAC3 but the bottom line is that it is better than UCAC2 for general astrometry since it does provide complete sky coverage. As always, the MPO software includes the proper motions from UCAC in the calculations for astrometry.

More Example Files and Updated Users Guide

The saying goes that you learn by doing. It's very true in the case of MPO Canopus and MPO LCInvert (which models asteroids). The Canopus/PhotoRed Users Guide has been extensively reworked and now includes tutorials on "Core Operations" such as AutoMatch, blinking images, and so on. Important new features have been integrated into to the tutorials so that you learn to treat them as part of the usual routine instead of exceptions. The Comp Star Selector in MPO Canopus is a prime example.

Additional example files have been included to allow you to work through more of the tutorials instead of just read about how things will work. This includes getting the lightcurve of an exoplanet (WASP-1, images supplied by Jerry and Cindy Foote).

More reliance and information has been put into the Users Guide with duplicate material removed from the Reference Guides. This makes the latter a little leaner and more direct to the point of explaining the philosophy and details of the programs than the "how-tos".

Automatic Data Conversion

For those using MPO Canopus, there is no longer a worry about having to run a separate conversion program to use v9.x files in version 10. The PHSESS/PHOBS, sess/obs export sets, AAVSO/AAVSO2, and UserStar catalogs are converted "on-the-fly" when Canopus first tries to access them. If you have colleagues still working with v9.x, you can send your v10 sess/obs files to them and they will still work. Of course, they will not have access to the new data fields in the version 10 files.

There are some files, not used as often, that will still require conversion if generated before v9.5. These include PhotoRed OBS files and MPO Connections scripts.

Convert10 Wizard

The Convert10 program that converts files to v10 is now a wizard that goes through a set of questions that make it easier to decide what needs to be converted and when. As mentioned above, you don't need to convert some files, unless – for example – you have a large number of sess/obs export sets and want to get them all converted at one time.

Those upgrading from before v9 ***must*** run the Convert10 program.

The updated Installation Guide will step you through all this.

Those are just some of the major changes. There are additional ones that do "clean-up" and fix bugs.

MPO Canopus

The most fundamental change in Canopus is how it works with the raw data when doing analysis. These changes are in anticipation of soon having highly-accurate comparison star magnitudes any where in the sky using the APASS data.

In short, the new method for finding the magnitude for a target is very similar to what's been used by the AAVSO and others for years: find the instrumental difference between the target and a comparison and then add the comparison's catalog magnitude to get the "true magnitude" of the target. Canopus allows finding the derived value using up to five comparisons. The benefits of this approach are that differential photometry is still the foundation for the measurements and not a determined offset and the provision for easily revising results after the fact should the catalog magnitude for one or more of the comparisons be updated.

These changes also mean a changing role for PhotoRed, the utility program that finds first/second order extinction and transforms for your system. Before, the pipeline would go from measuring time-series data in Canopus, importing that data to PhotoRed to put it on a standard system, and the exporting back to Canopus for additional analysis. For the most part, PhotoRed's role has been eliminated, with the important exceptions of still finding the extinction and transforms for your system and batch image processing for AAVSO work.

The following sections are taken from the revised Canopus/PhotoRed manual and Users Guide. The latter will be available free on-line at the MPO web site. They are only brief introductions to the changes in the software in regards to doing time-series photometry. There are many other, smaller, feature enhancements and improvements throughout.

Variables Stars Welcome Here

Much of the discussion about the changes is in relation to asteroids; that's because they move and so those doing asteroid lightcurve work don't have the benefit of using the same comparison stars every night, stars that are often in well-calibrated sequences from the AAVSO or other source. Don't get the wrong idea: Canopus is for time-series work regardless of the target. The AAVSO routines have been updated to include Sloan (SDSS) filters and to make batch processing more efficient.

A Matter of Magnitudes

Canopus always records the "instrumental" magnitude of a comparison or target. This is computed directly from the sum of the ADU counts for the object and then normalized to a 1-second exposure. This means that even images with different exposure times can be directly compared among one another, assuming the same system was used.

- *The instrumental magnitude is independent of any catalog used. It is strictly a function of the system that took the image.*

Canopus can also record a true magnitude (*TrueMag* from here on). This is based on a solution using the measured instrumental magnitude versus the catalog magnitude for up to 75 images in the star. For each star, the difference between instrumental magnitude and catalog magnitude is computed (m-M). The mean and standard deviation of these results comprise what is called the Magnitude/Intensity Relationship (*M/IR* from here on). If you think about it for a moment, in a perfect world, the instrumental magnitude should vary in direct proportion to catalog magnitudes, e.g., a star that is one magnitude brighter in a catalog should have an instrumental magnitude that is also one magnitude brighter. Of course, this is not the case.

Errors in the catalog values, measurement of the instrumental magnitudes, and differences in the color of the stars used in the data set contribute to some degree of uncertainty. These are all wrapped up into the standard deviation of the mean of the m-M differences, or at least to a first order approximation. These are only the "internal" factors. External conditions such as variable observing conditions mean that the solution for one image may not be the same as for another image, e.g., if a slight haze moves in, the instrumental magnitudes are all fainter, and so the "offset" (m-M) is different.
The MPOSC3 catalog provided with MPO software includes the Carlsberg Meridian Catalog (CMC-14) as well as data from the Sloan Digital Sky Survey (SDSS). These magnitudes are mostly SDSS r' with some g' and i' when available. Almost all stars in MPOSC3 also have BVRI magnitudes derived from 2MASS J-K magnitudes (see Warner (2007). *Minor Planet Bulletin* **34**, 113-119). These have an internal consistency of ~0.05 mag for V and 0.03 mag for R. Many tests have been run using the magnitudes from the MPOSC3 catalog, mostly to link data sets from many nights. Generally, individual sessions "fall into line" to within 0.02 mag when using a calibration method involving the Comparison Star Selector and instrumental magnitudes.

↳ *"Catalog-based" magnitudes are those referenced to the magnitudes within a given catalog (or standard photometric system). This term is used instead of "absolute" to avoid confusion with the standard definition of "absolute magnitude", which is the brightness of a object (usually a star or galaxy) when it is 10 parsecs from Earth.*

How Does Canopus Work?

There are three basic approaches in Canopus. Two involve differential photometry.

Differential Photometry

This is where the difference between a target and comparison (or average of several comparisons) is found for each image. It is this differential value that is used in analysis.
Since, in most cases, any variations caused by external factors are the same across the entire image, this approach nullifies those factors. What remain are the internal factors, the differences in color between the object and comparison stars usually dominating things.

↳ *You must take care not to use stars that are beyond the linear response of the camera, let alone that are saturated – even if it's only one pixel out of dozens.*

Instrumental Photometry

For MPO software, this will mean that instrumental magnitudes are used for *differential photometry and that no offset is applied to put the differential values on a standard system*. These will be called *Instrumental* in this Guide.

Catalog-based Photometry

This approach uses the M/IR to compute the magnitude of the target directly and ignores the comparisons altogether. If the M/IR is computed image by image, then this reduces but does not eliminate external factors. Under good conditions, this approach produces good results catalog-based magnitudes. However, one cannot be sure if "good conditions" prevailed throughout a session. These will be called *TrueMags* in this Guide.

A Hybrid Approach (Derived Magnitudes)

Another approach, one that Canopus can use and is recommended is a hybrid of the two methods. It's one that's long been used by the AAVSO for submitted CCD observations. In this case, you find the

instrumental magnitude difference between the target and comparison ($m_t - m_c$) and then add the catalog magnitude of the comparison. This results a catalog-based magnitude for the target. If you use several comparisons, you end up with several values for the target. The mean and standard deviation of that mean can be used for the final value for the target. These values will be called *DerivedMags* in this Guide.
The AAVSO Batch Processing routines in PhotoRed extend this approach to allow correcting for the color difference between the target and each comparison separately and then to output the data in special files that are used to generate reports specifically for the AAVSO.

This is the recommended approach for almost all measuring for time-series photometry. It gives catalog-based values while retaining the (considerable) virtues of differential photometry using instrumental magnitudes.

Selecting the Analysis Method in the Configuration

When you want to use simple differential instrumental magnitude values (*Instrumental*), you will select Configuration | Photometry magnitudes | Method | Instrumental.

If you want to use *DerivedMags*, select the "Derived" method

If you want to use the "pure M/IR" magnitudes (*TrueMags*) that ignore the comparison star set entirely, select "Transformed".

All three of these methods will include corrections for changing geometry and/or phase (if appropriate) when doing period analysis. These corrections are mandatory in order to do proper analysis. The "Transformed Absolute" method does not include these corrections.

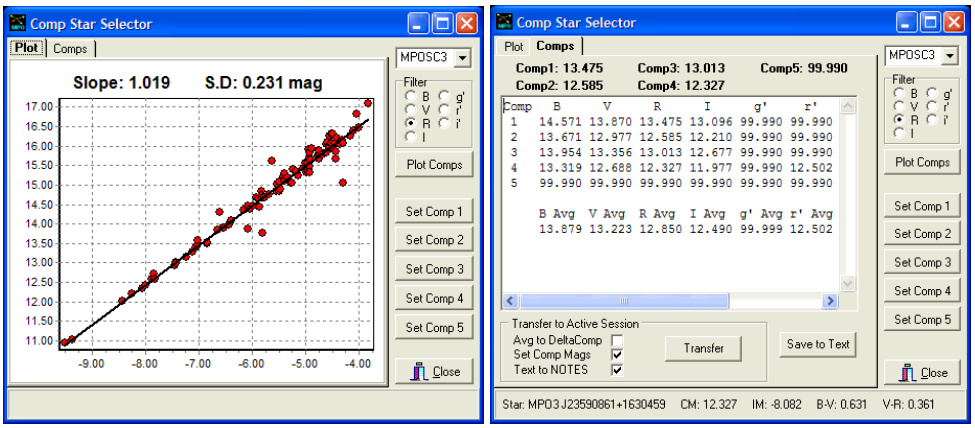
Deprecated Methods

"Transformed" and "Transformed Absolute" have been retained in the current version of Canopus but should be considered "deprecated", meaning that they are no longer recommended and used very infrequently. The main reason for retaining them is to work with data that has been converted to standard magnitudes in PhotoRed and then imported back into Canopus. In those cases, you do not want to make further use of the comparison star set since that was done in the PhotoRed processing.

Reduced Magnitudes

Canopus offers the option of outputting "reduced magnitudes". This is where the target magnitudes are changed using the "unity correction" of –5*log(EarthDistance * SunDistance). This makes the correction for changing distance independent of any session. Without the correction, which is still valid, the reference distance becomes that of the asteroid on the date of the first session.

The Comp Star Selector



The Comp Star Selector (CSS), that was introduced in version 9.5, takes on a more critical role in version 10. With it, you can transfer the catalog magnitudes of the selected comparisons directly into the active session. It can also transfer all the comp star data into the Notes field of the active session for future reference.

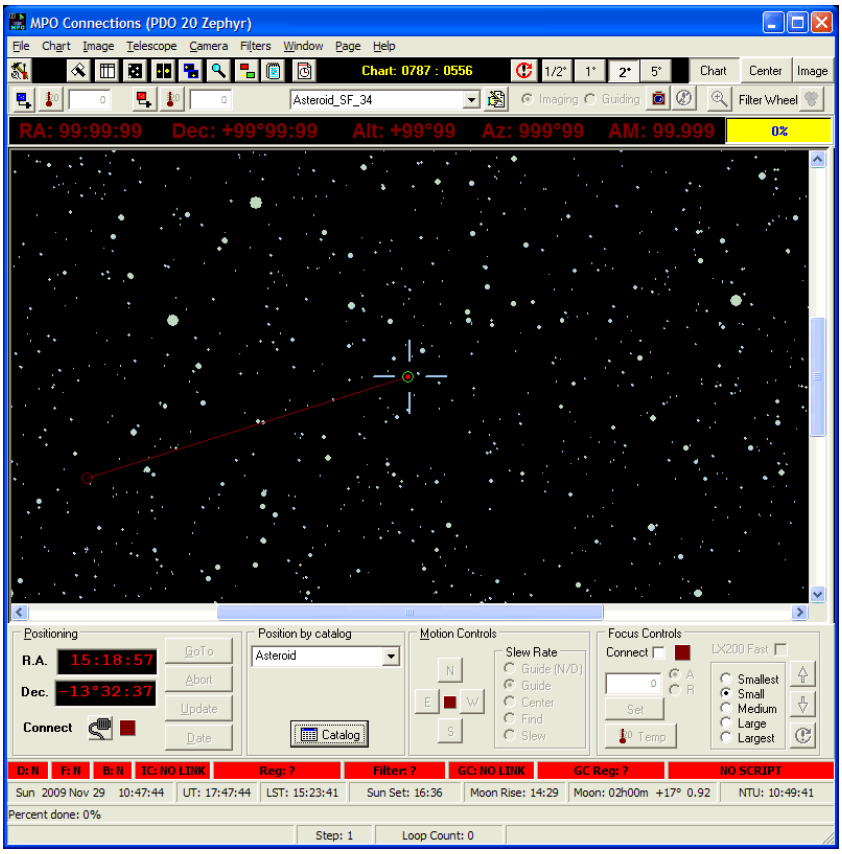
In v9.5, the CSS has proved invaluable in linking night-to-night sessions, putting them all on a common zero point to within 0.05 mag, often much better. The new methodology in Canopus will mean even better results, especially when APASS comes on line.

The Users Guide

I urge you to download the Users Guide and go through it, even if you're an experienced Canopus user. Things have changed – for the better, I think – and so you'll want to become familiar with those changes.

MPO Connections

Displaying Asteroid Positions in Real Time



Connections can compute the positions of all asteroids in the MPCORB file and then display their locations and 24-hour path. The current positions are updated automatically every five minutes or when you force Connections to update. In the screen shot above, the red dot with green circle is the original position of the asteroid. Over time, the red dot moves along the path towards the dark red circle that indicates the predicted position of the asteroid 24-hours after the initial calculation.

Admittedly, this is not Earth-shattering but it is a noteworthy improvement for those working asteroids.

Some Other Enhancements

Connections now incorporates the MPOSC3 catalog, and draws its charts faster.

You can define the guiding box on the chart so that it truly matches the field of view of your guider.

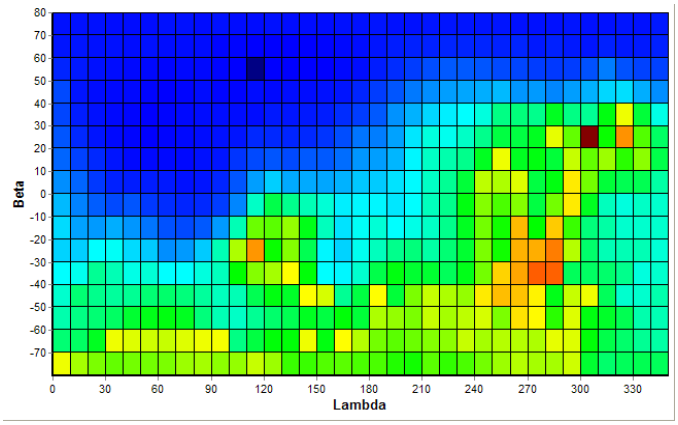
FLI MicroLine and ProLine cameras are supported. Sorry, Starlight Express is still on the “to-do” list.

On SBScripte6 (scripting for TheSky6 and CCDSoft) is included. SBScripter5, which supported TheSky5 is no longer included.

MPO LCInvert

LCInvert is the program that does spin axis and shape modeling of asteroids by inverting lightcurves. This is fast becoming an important area of research for backyard astronomers.

Graphical Pole Search Results

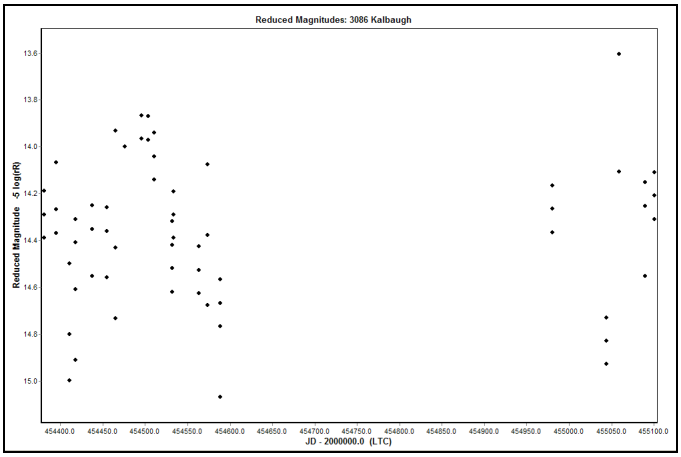


When doing a search for a pole, LCInvert creates a color-coded plot of the solutions to help you with refining the search. The "best" solutions are shades of blue and the "worst" are red. In the plot above, the longitude of the pole is likely around 90° but more important is that the latitude is positive for all "good" solutions, indicating the asteroid is rotating in a prograde direction.

Canopus Import

LCInvert accepts Canopus data in two formats: the Condensed file or the results of exporting the entire data set for a given star (the "To File" button on the sessions form).

Survey Data Import



The feature to import data from surveys using files from the AstDys site has been expanded to use data taken in a given filter and to plot the reduced magnitudes of the data. This gives a visual check for outlier data points and the overall quality.

So! What's it Gonna Cost Me?

No one likes to buy anything, from software to a car to a washing machine only to see it go on sale the next day or to see a "new and improved" version of software released before the credit card bill arrives for the "old and not as good" version.

Version 10 requires 2 DVDs of my making: the Setup with Examples and the MPOSC3. After the original supply of UCAC3 DVDs run out, I'll have to roll my own. This makes for higher materials cost, so I can't just give the software away.

However, I'm also not raising the price for a new purchase, despite these additional costs and rising postal rates.

If you miss a cutoff date by one day, I apologize. I have to draw a line somewhere. I've been on both sides and can empathize but given that it's been almost three years since I've asked for any money to upgrade, I hope that you'll have equal empathy.

V9.x Purchased on/after 2009 August 1 AND V9.x Educational License on/after 2009 January 1

The upgrade pricing will be as follows:

All Products $15 each ($20 outside North America).

There is no upgrade pricing for MPO 2010.

V9.x Purchased Before 2009 August 1

The upgrade pricing will be as follows:

MPO Canopus:	$40
MPO Connections	$50
MPO LCInvert	$75
MPO 2010	$20 ($25 outside North America) This is an annual purchase. There is no upgrade pricing.

Shipping and Multiple Upgrades

Recent postal rate increases were more than expected. So, the prices above reflect North America shipping only. There will be a $10 charge for international shipping per order, which can include one or more products.

The above pricing is per product. There is no discount for multiple upgrades on a single order.

V8.x and Before

Full purchase price. There is no upgrade pricing.

When Can I Order?

Orders are being taken now.

When Will it Ship?

Shipping has begun with orders being processed on a first come/first served basis.

What Technical Support will be Available?

I'll be available for email support through the end of the year, with a little slower response between Christmas and New Years. If there are issues that cannot be resolved by email, e.g., defective product, I will not be able to service those at all between December 23 and January 3.

Will You Still Support V9.5?

I will still answer all questions about v9.5 for one year (2010 December 31) but there will be no more updates or fixes. Starting 2011 January 1, tech support for 9.5 will be limited to general questions.

The current "QuickFix" Canopus and Connections on the MPO web site are the "final" versions.

What About Updates?

Updates (minor fixes, enhancements) to version 10 only will continue to be free and, most likely, only in the form of "QuickFixes" (replacements for the EXE file). I do not anticipate any changes so extensive as to require a large SETUP file.

Can I Run v9.5 and v10 on the Same Machine?

It is not recommended. The client-server nature of the software and the use of the same database aliases mean that v9.5 and v10 will be "competing" for files with some unpredictable consequences.

I'm Worried about Installation and Data Conversion

In the past, there was reason for concern. However, v10 converts the critical user-maintained files on-the-fly when the program starts. There is no need to run the Convert10 program unless you have lots of exported data from Canopus or are upgrading from before 9.5 and even then, only to update the PhotoRed observations data and MPO Connections script files.

You should make a good backup of the "Mighty Five" files (described in the Installation Guide) and all export sets (formerly called "Save Session Files" that were usually saved in \MPO\UDATA) and then uninstall all MPO v9.5. You may have to remove the MPOSC and MPOSC2 manually using Windows Explorer. Then install v10. Copy your backups of the "Might Five" to \MPO\COMMON. These files will be converted on-the-fly when you open any MPO program that uses them.

The first rule: always make good backups of any data files that you caused to be created or updated. This does not apply to the catalogs such as MPCORB and such. Those are installed anew when you install version 10.

The second rule: if you're not sure, contact me *before* you do anything.

Disclaimer

All pricing and policies are subject to change without notice