

**Astroart 3.0 - is a complete software for image processing, photometry, astrometry, CCD control and image stacking for CCD and film images.**



- **Advanced filters:** Maximum entropy deconvolution, Richardson Lucy, adaptive, Larson Sekanina, unsharp mask, DDP, FFT, erosion, etc ... with full preview.
- **Astrometry and photometry:** with integrated star atlas, GSC included, USNO supported; MPC reports, aperture photometry, estimation of measuring errors.
- **Image stacking:** Automatic on sets of images, with sub-pixel precision. Four algorithms (one star, two stars, planet, correlation). Alignment and rotation.
- **Color imaging:** Native 96 bit, visualized in real time. All the filters work on color images. Quadrichromy LRGB and WCMY with automatic L.A.B. conversion.

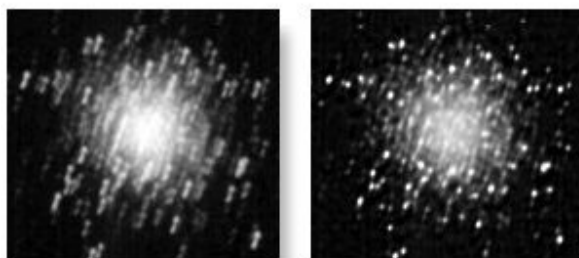
**Astroart 3.0 is an *open system* with plug-in support. All programmers of C/C++, Visual Basic, Delphi can create plug-ins using the free SDK.**

□ **Other features:** Macro commands applicable on groups of images, automatic preprocessing (master dark frame, master flat field), FFT transform, real-time 3D window, zoom and histogram. Profiles, statistics, image registration (rotation and scaling), isophotes, blink. Imports more than 20 CCD file formats; saves Color FITS, TIFF, ASCII, BMP and JPEG.

□ **High speed:** Astroart is a extremely fast software thanks to its code optimized in *assembly* for Intel and AMD CPUs. For example, color maximum entropy performs more iterations in less time; up to 4x faster than other software. This makes Astroart fully usable on old PCs with 32 Mb RAM. Windows in 256 colors supported.

## Deconvolution

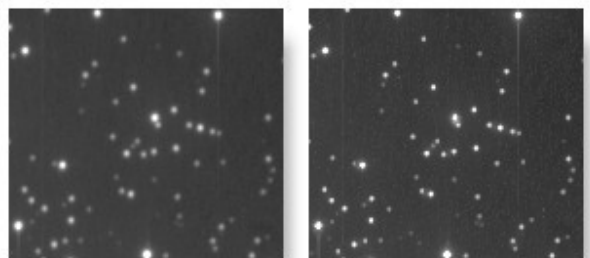
With the deconvolution commands of Astroart it is possible to restore an image corrupted by blur or bad tracking. Some amateur astronomers use this feature to restore also film photos;



This image is a two minutes exposure of M13 with a TMAX 400 B&W film. The image was not tracked but after the Maximum Entropy deconvolution it is perfectly restored. This image was scanned with a low cost A4 scanner.

## Adaptive filters

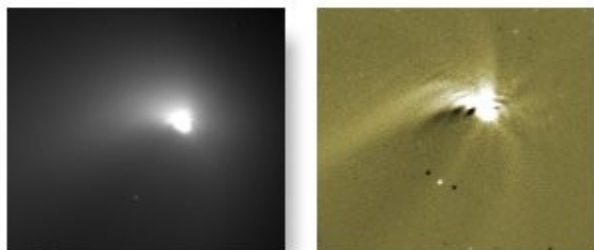
Astroart contains two unique adaptive filters. The Non-Linear high pass filter improves the sharpness of an image without black rings around stars or other artifacts.



The Adaptive Low pass reduces the noise of an image without blurring and without losing definition. *Try them in the demo version.*

## Fast rotational gradient

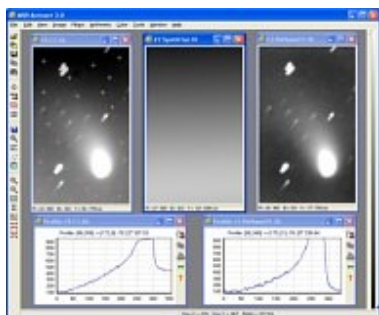
The rotational gradient filter, also known as Larson-Sekanina, can reveal faint details and jets inside comets.



Thanks to the speed of Astroart, this complex filter takes less than a second on a 512x512 image, using a 1 Ghz PC.

## Gradient removal

This is a filter available as free plug-in. It can correct almost any kind of uneven level of brightness in your images (usually caused by light pollution)



In the screen-shot above, the three processing steps on a comet image: at left the original image (note at the bottom the intensity profile), the "synthetic flat field" and finally the corrected image on the right.

## Stacking images before filtering

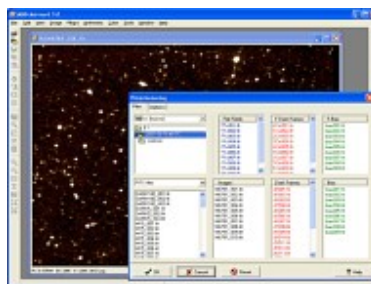
An high pass filter (sharpen filter) should be applied on a picture only if the noise hidden in the image is very low. This is usually false for a single shot of a planet.



On the left a single saturn image after an *Unsharp mask* filter, the noise become visible. On the right 20 frames was averaged (and automatically aligned) before filtering.

## Preprocessing

On the background there is a raw image of a sequence with a star selected as reference for the automatic alignment. On the foreground the powerful *Preprocessing Window* with the file boxes filled by a simple *Drag & drop*.



In a few seconds all the images are corrected for dark frame, flat field, aligned and summed into a single image. Note that the Dark frame and the Flat field are not a simple file; it's the result of a list of files, by average or median.

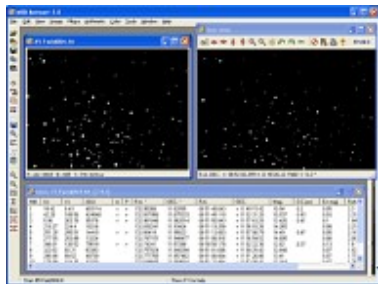
**" Astroart is a great example of how astro software should be planned, coded and documented. "**

Warren B. Offutt , W & B Observatory. USA

**" When science is done properly it is indeed art."** Michael Schwartz , Tenagra Observatories

## Astrometry and photometry

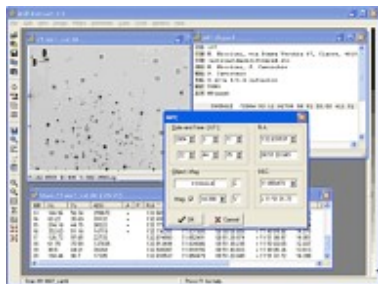
The astrometric and photometric calibration was the main feature of Astroart. It is assisted by a integrated star atlas (18 Million stars, up to 15° mag. compressed into 250 Mbytes on CD), based on the GSC catalog. The USNO catalog is also supported (all stars up to 19.5° mag).



With just a few mouse clicks it's possible to assign the reference stars of the image, for the subsequent reduction. Since 1998 many amateur astronomers are using Astroart for photometry and astrometry on comets, minor planets and supernovas.

## MPC reports

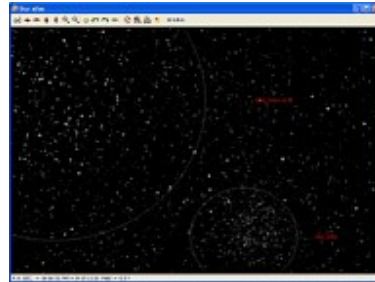
After measuring RA, DEC. and magnitude of minor planets or comets, a correctly formatted report should be sent to the MPC.



Astroart automatically creates a correct report from your measures, saving you a lot of precious time.

## The star atlas

This is one of the **fastest** star charts available now for Windows. On a standard PC (1 Ghz) it can explore the star fields at 10 frames/sec. old using the GSC and USNO together (all stars until 19° magnitude) For every star it's included the maximum error (position and magnitude).



The star atlas is not a "planetarium": planets, eclipses etc. are not included, we recommend *Guide™*, *Skymap PRO™* or *Perseus™* for this purpose. The atlas can be used **rotated** by any angle to easily identify the photographed zone.

## Header FITS

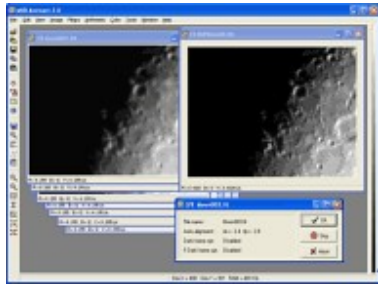
Astroart strictly follows all recommendations of FITS and WCS standards, and let the user to edit safely the Header.



The Header can be used as a simple text file, with Copy and Paste, and some keywords can be saved in the Preferences.

## Auto-alignment

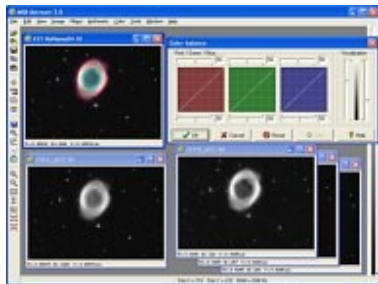
Since no telescope can track a lunar photography, to increase the signal to noise ratio it is necessary to take many images and then sum them.



But every image will be probably shifted and a software auto-alignment is then compulsory. The lunar image on the right is the sum of 9 frames.

## Trichromy

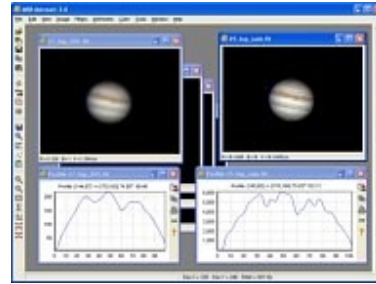
Astroart fully supports RGB and CMY tri-colour imaging as well as LRGB and LCMY, with standard L\*A\*B color conversion.



This example shows the benefits of using a fourth frame (luminance). Bad tracking and noise in the color frames don't affect the sharpness of the final image.

## Planets

This is a simple example of a processing on some frames of Jupiter taken with a video-camera.



The best 25 frames are summed together to increase the signal/noise ratio, then a high-pass filter was applied. The profile graphs confirms the improvement. (Courtesy M. Facchini, Cavezzo Observatory, MPC 107).

## Common pictures

With Astroart it is possible to apply the most powerful filters like Deconvolution and FFT to your own photos.



Working with 96 bits (32 for every R,G,B channel) it is possible to correct better the defects and to balance accurately the colors.

## Supported file formats

FITS (.fit, .fts, .fits) 8, 16, 32 bit, (integer and floating point); Hi-SIS and Audine 16 bit (.pic); SBIG 8, 16 bit; Starlight XPress 12, 16 bit; PixCel 255-237 16 bit; Cookbook 12 bit (.pix, .p1-3, .pa-b); Lynxx 12 bit (.ccd, .lnx); Electrim 8 bit (.elm, .tif); TIFF 8, 16 bit (.tif) gray levels, not compressed; TIFF 24,48 bit (16 bit x 3 colors), TARGA 8, 16 bit (.tga) gray levels; BMP and JPEG, ASCII 8, 16, 32 bit (.txt); GENERIC FORMAT with custom size (up to 8000x8000 pixels), data types (8, 16, 32 bit integer & f.p.; signed, unsigned, PC or MAC).

## File export

FITS 8, 16, 32 bit and color; ASCII 32 bit; RAW 32 bit; TIFF 8, 16; TGA (256 gray levels); BMP, JPEG 24 bit colors. Print with options for orientation and scaling.

## Image editing

Functions of UNDO, COPY (whole image or a selection) and PASTE (as a new image or into selection). CREATE new images (artificial images) with the possibility to insert statistical and gaussian noise with a given sigma. SELECTION of pixels and rectangular areas. EDITOR of pixels in real time. DUPLICATE of an image, FLIP horizontal, vertical or both. Automatic ALIGN of images using centroids (for star fields) or correlation (for the moon), automatic for planets. Sub-pixel precision. ROTATE, Sub-pixel SHIFT of the image. RESIZE: bilinear and bicubic. DIGITAL BINNING (2x2 and 3x3). Transformation of coordinates: from POLAR TO RECTANGULAR and RECTANGULAR to POLAR. COREGISTER of two images of the same image but with different magnification and/or rotation of field.

## Photometry and astrometry

STARS WINDOW with automatic DETECTION of stellar objects (selectable FWHM and S/N) and automatic PSF integration: all the objects are catalogued in an interactive data-sheet with X and Y position of centroids, intensity in ADU, FWHM on X and Y axes, S/N ratio, RA, DEC. ASTROMETRIC and PHOTOMETRIC CALIBRATION based on one (or more) of the Star Atlas catalogues: (GSC, USNO SA1.0, SA2.0 or USNO A2.0): all catalogue data, like position and magnitude are editable for your own correction, estimation of measuring errors. Measure of angular separation, APERTURE PHOTOMETRY, measure of brightness both in ADU and in magnitude; automatic background detection or user defined. Automatic compilation of a MPC REPORT (Minor Planet Center) correctly formatted. WCS (World Coordinate System): reading and/or writing of the FITS keyword based on this standard astrometric system. Easy and safe EDITING of FITS HEADER like a text file.

## Filters and image processing

LOW-PASS FILTERS (light, medium, heavy, Gauss, FFT, adaptive) HIGH-PASS FILTERS (light, medium, heavy, optimal FFT, adaptive) UNSHARP MASK (with user-defined sigma e coefficient), EROSION filter, AVERAGE and MEDIAN on a customizable matrix of coefficients, removal of hot and cold pixels, DDP. CONVOLUTION FILTERS (up to 15x15 matrix) and calculation of the PSF. DECONVOLUTION of MAXIMUM ENTROPY, WIENER, VAN CITTERT and RICHARDSON-LUCY. Contour filters, SOBEL, PREWITT, FREEMAN, KIRSH, GRADIENT, LARSON-SEKANINA for comets.

REPAIR of columns and rows. Average or median BINNING on X and Y axes for spectroscopic applications. Background NORMALIZATION with a reference image. Automatic DARK FRAME OPTIMIZATION with different temperatures and/or time exposures.

## Image analysis

HISTOGRAM: linear, logarithmic and exponential transfer functions with fine tuning of BRIGHTNESS, CONTRAST, LOW AND HIGH THRESHOLDS. PALETTES: gray scale, negative, saw-tooth rainbow, flame, jazz or fully customizable. ZOOM WINDOW in real time with functions of photometry, auto-contrast, palette and printing. 3D WINDOW in real time with change of point of view. STATISTIC WINDOW of the whole image or a selected area. ISOPHOTES with user defined steps and thresholds. PROFILE WINDOWS with functions of zoom, printing and exporting to file. BLINK of 2 images with auto alignment. BLINK of 3 images. Night visualization. FFT transform and inverse transform, to analyze and correct the periodic noise of the image.

## Math functions

SUM, SUBTRACT, DIVIDE, MULTIPLY, MINIMUM, MAXIMUM, DISTANCE, AVERAGE, MERGE (fully customizable, i.e to perform DDP processing), ADD OFFSET, PEDESTAL, MULTIPLY or DIVIDE by a coefficient, CLIP minimum and maximum.

## Tools

User-defined MACRO COMMANDS with simple *drag & drop* to process many images at the same time. Fully customizable PREPROCESSING: sum or average of images, automatic or manual ALIGNMENT, correction for dark-frame, flat field and bias using sets of frames. TRICHROMY with LRGB and LCMY. Integrated STAR ATLAS with 15 millions GSC stars. The same atlas can read other CD-ROM catalogues like USNO SA1.0, SA2.0 or USNO A2.0. HIGH SPEED (USNO A2.0 display in real time, 10 frame/sec on a P200), printing of high quality sky maps. Supports PLUG-INS, with free SDK and technical support. CCD control also available as plug-ins, with telescope control.

NOTES: