

TSX uses an embedded program, SExtractor, for light source extraction in support of Image Link. SExtractor was originally designed for measuring galactic light sources, but is used in TSX for stellar astrometry. The SExtractor documentation will tell you that SExtractor is not intended for rigorous photometry. However, it's not bad for some amateur purposes like selection of stars for autoguiding.

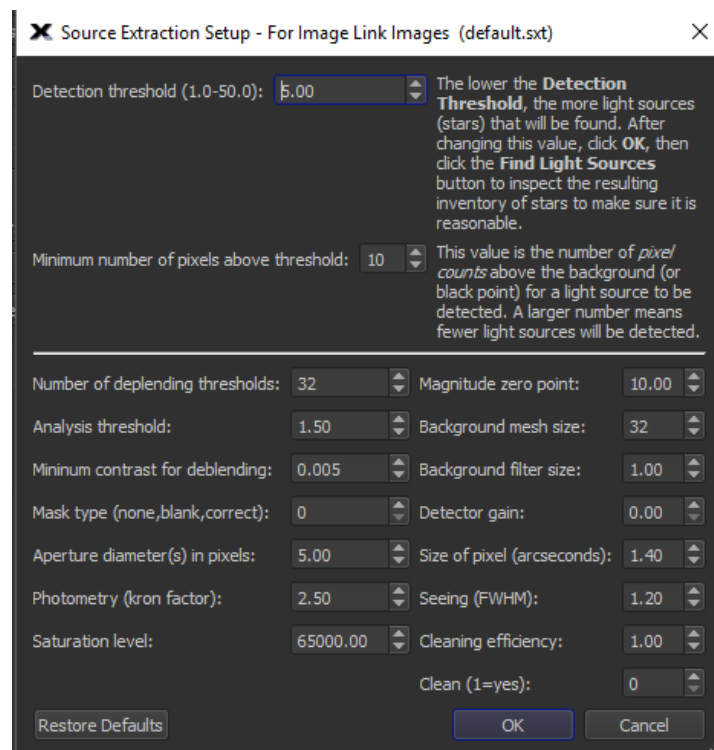
The user documentation for SExtractor is called “*Source Extractor for Dummies*”, written by B. Holwada of the Space Telescope Science Institute. It can be found at:

http://astroa.physics.metu.edu.tr/MANUALS/sextactor/Guide2source_extractor.pdf

Frankly, I think it is still a tough read for anybody but an astro-imaging doctoral candidate, but the actual SExtractor specification document is much worse. Yet, *Source Extractor for Dummies* remains the sole documentation, however obtuse, for the TSX Source Extraction Setup. “*Source Extraction for Dummies*” refers to several different versions of the application, but I haven't found mention of which version TSX uses.

Essentially, SExtractor starts with baselining the image by removing all pixels below a defined threshold and without a sufficient number of neighbors. The remaining blobs of pixels are separated into distinct objects then their intensity filtered and normalized against the surrounding background. Astrometry functions then determine the shape, size and location of each object, and photometry functions determine their magnitude. Additional processing assigns a type to each object (i.e. star to galaxy).

Below I've tried to deduce from the document, to the best of my ability, how each **Source Extraction Setup** parameter and the relevant **ccdsoftImage** class method relates to the SExtractor functions. For photometry automation, the two critical parameters would be the Detector Gain and the Magnitude Zero Point, although neither turns out to be particularly useful. None of these parameters are programmatically available (e.g. JavaScript).



Description of TSX Light Source Extraction parameters as deduced from “Source Extraction for Dummies”:

TSX Source Extraction Setting	SExtractor Input Variable	Astrometry (position) Use	Photometry (brightness) Use	Explanation
Detection threshold (1-50):	[DETECT THRESH]	x		Sets the minimum intensity (ADU) for a pixel to qualify as part of a light source.
Minimum number of pixels above threshold:	[DETECT MINAREA]	x		Sets the minimum number of adjacent, qualified pixels for that group to qualify as a light source.
Analysis threshold:	[ANALYSIS THRESH]	x		Sets the minimum intensity, relative to background RMS, for the pixels in a light source when determining Star Class and FWHM.
Number of deblending thresholds:	[DEBLEND NTHRESH]	x		Sets the intensity granularity for determining whether peaks an aggregate light source qualify as separate light sources.
Minimum contrast for deblending:	[DEBLEND MINCONT]	x		Sets the minimum number of adjacent pixels (as fraction of the total pixels in an aggregate light source) for a peak and its adjacent pixels to qualify as a separate light source.
Mask type (none, blank, correct):	[MASK TYPE]		x	Sets method of masking light source neighbors when performing photometry functions: 0 – none 1 – set neighbor’s pixels to zero 2 – adjust neighbor’s pixels symmetrically to target source’s pixels
Photometry (Kron factor):	[PHOT AUTOPARAMS]		x	Sets the total light summing area of an object by scaling up the radius computed to be the Kron radius (90% of object’s light)
Aperture diameter in pixels:	[PHOT AUTOAPERS]		x	Sets a minimum radius (in pixels) for the photometry measurements (if the scaled Kron radius is too small).
Saturation level:	[SATUR LEVEL]		x	Pixel value (ADU) above which the light source is considered saturated.
Detector gain:	[GAIN]		x	Sets the -e/ADU for CCD that is used only for error estimations.
Magnitude zero point:	[MAG ZEROPOINT]		x	Sets an offset that is added to calculated instrument magnitude to produce the output magnitude value.
Background mesh size:	[BACK SIZE]		x	Sets height/width (in pixels) of a mesh for computing the background RMS. Should exceed maximum light source size.
Background filter size:	[BACK FILTERSIZE]		x	Sets height/width (in meshes) applied during smoothing of the background RMS.
Size of pixel (arcsec):	[PIXEL SCALE]		x	Arcsec/pixel of the CCD image (as binned, if any.)
Seeing (FWHM):	[SEEING FWHM]	x		Spread, in arcsec, of a point light source in the image due to seeing conditions.
Clean (yes/no):	[CLEAN]	x		Determines whether light source list should be “cleaned” of artifacts caused by bright objects.
Cleaning efficiency:	[CLEAN PARAM]	x		Sets the aggressiveness by which light sources are “cleaned”. Lower increases aggressiveness.

Description of TSX output values for **ShowInventory** (or **WCsInsert**) as derived from “*Source Extraction for Dummies*” (and a few experiments):

ccdsoftImage.ShowInventory Array	SExtractor Output Variable	Astrometry (position) Use	Photometry (brightness) Use	Explanation
cdInventoryX	X IMAGE	x		Horizontal location of light source measured in pixels.
cdInventoryY	Y IMAGE	x		Vertical location of light source measured in pixels.
cdInventoryMagnitude	MAG BEST (?)		x	Turgidly described sum of the flux around the general area of the light source, corrected to the background RMS and normalized to $2.5\log(\text{flux})$.*
cdInventoryClass	CLASS STAR	x	x	Vaguely derived classification for the light source: 0 = galaxy; 1 = star.
cdInventoryFWHM	FWHM WORLD	x		PSF width, assuming a Gaussian profile, in pixels
cdInventoryMajorAxis	A IMAGE	x		Major axis of light source measured in pixels.
cdInventoryMinorAxis	B IMAGE	x		Minor axis of light source measured in pixels.
cdInventoryTheta	THETA IMAGE	x		Position Angle in degrees, CCW from North.
cdInventoryEllipticity	ELLIPTICITY	x		$1 - (B \text{ IMAGE} / A \text{ IMAGE})$

*Experiments over the whole of an image's light sources, when compared to actual magnitudes for the associated cataloged stars, show a mean deviation of over 2 magnitudes, in general. That is, this output parameter is useless for photometry.