Summary of progress on source extraction

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1 Summary of outcome of 2006 tests

Basically, the performance of Sextractor is in accordance with the theoretical limits when using 7 pixels per FWHM beam and a signal to noise ratio between 3 and 100, as shown in plots 1 and 2. The theoretical 1σ accuracy of photometry is of the order of the rms noise and the 1σ astrometry error is about equal to the beamsize divided by the signal to noise.

2 January 2007 tests

When using less than 7 pixels per FWHM beam and/or a signal to noise ratio higher than 100 Sextractor's performance with regard to photometry and astrometry becomes worse than the theoretical limits. When using fitting routines one can still attain the theoretical limits as shown in plots 3, 4 and 5. Fitting routines are not included in the Sextractor package. A consequence of this is that pixellation effects become apparent in the Sextractor output at a lower signal to noise ratio than packages that include Gauss fitting, like the AIPS task SAD. The astrometry performance of software packages that include Gauss fitting do not seem to suffer from pixellation effects at any signal to noise ratio. The photometry of these packages does break down at some point, but at a very high signal to noise ratio, as can be seen in plot 3.

3 Future work

There is a very nice framework in Python for source extraction which uses the numarray routines. At the most basic level it is about twice as slow as Sextractor (with exactly the same output) but this can probably be improved. The main advantage of the Python framework is its incredible flexibility, it is very easy to add anything that Sextractor cannot do, like changing the definition of a source, correct for the primary beam, incorporate a FDR algorithm, measure the flux at a predefined location, pass on keyword values from the FITS header, do all kinds of fitting, account for a varying PSF across the image, etc. The more computationally intensive stuff can be extended in C, but every extension will make the source extraction process slower, of course.

Another bit of work involves investigating the relation between the noise characteristics of a radio map and the number of false detections as a function of threshold level.

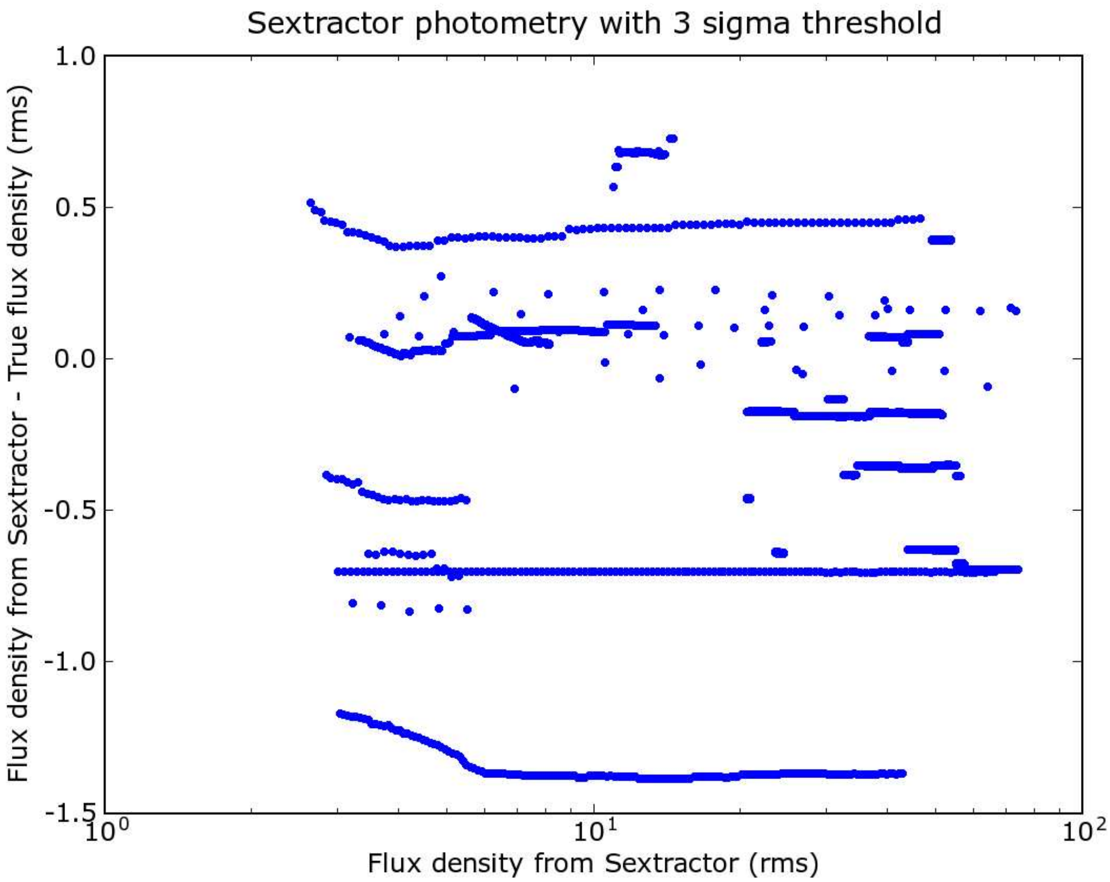

Figure 1: Flux error, i.e. the difference between the fluxes derived by Sextractor, using the maximum pixel method, and the true fluxes of the inserted sources, expressed in units of the rms noise. Theoretically the 1σ deviation of those differences, is given by the rms, so that would be indicated by horizontal lines at the level of plus and minus one in this graph.

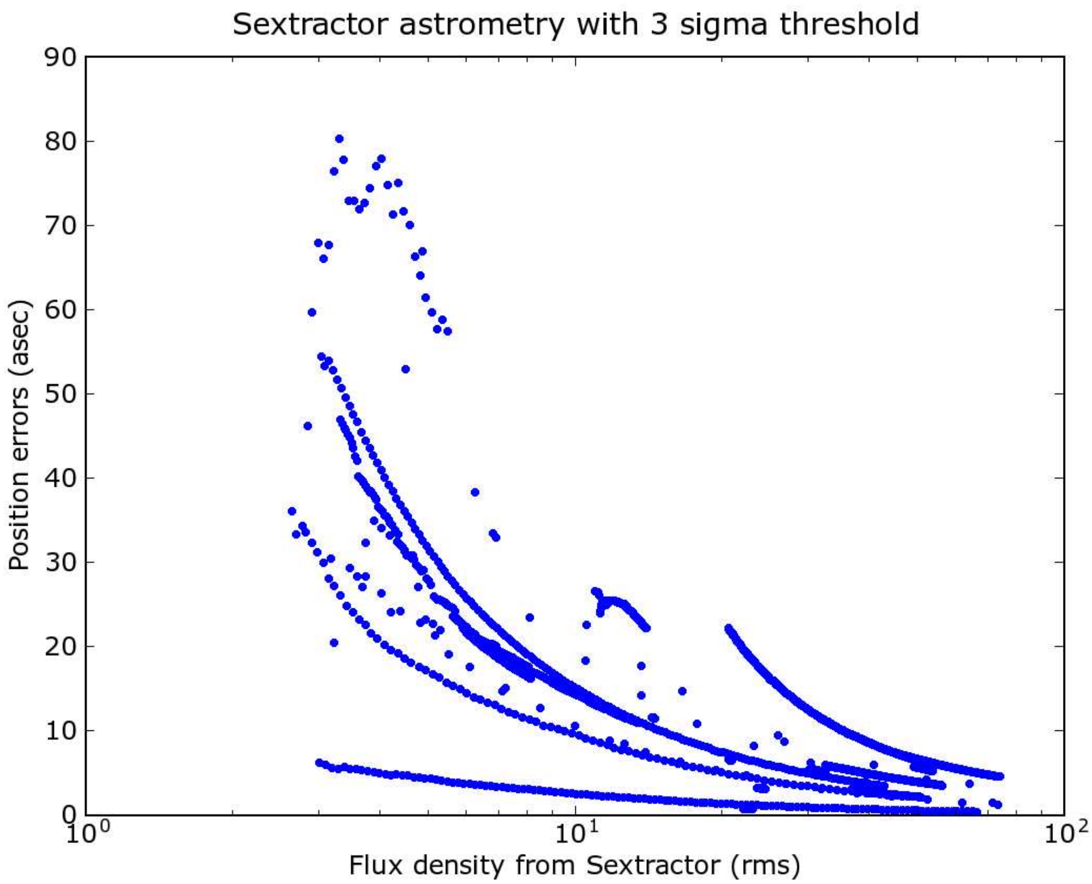

Figure 2: Position error, i.e. the difference between the positions derived by Sextractor, which uses the barycenter method, and the true positions of the inserted sources. The beamsize is 327"*274".

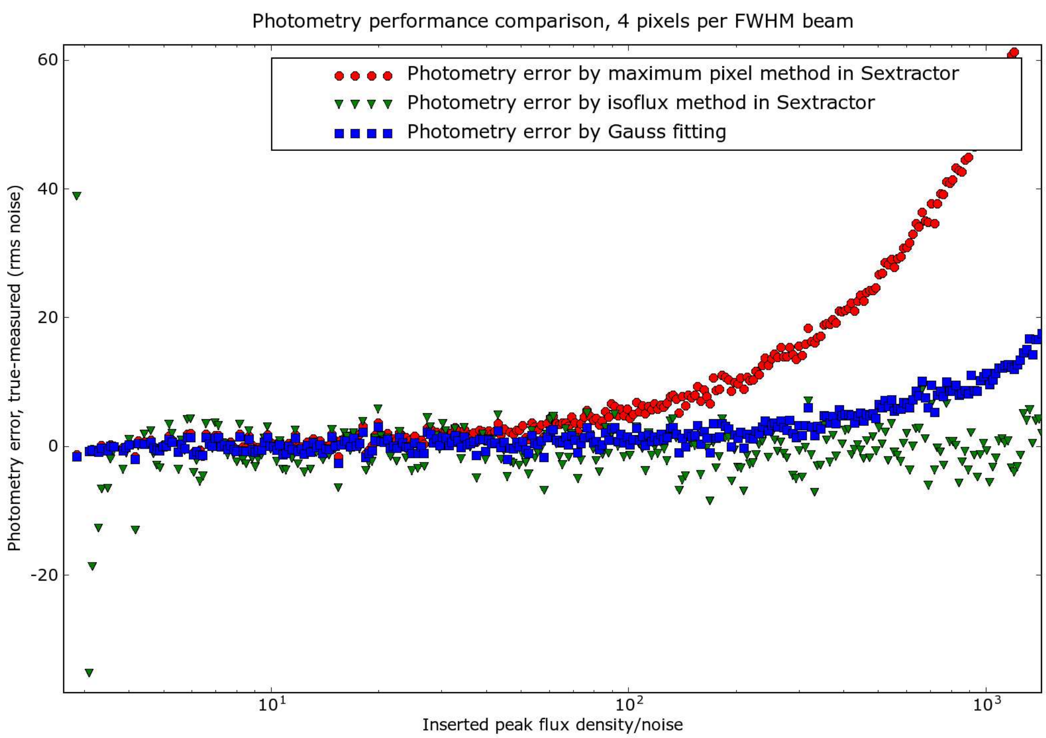

Figure 3: A systematic error in the maximum pixel photometry by Sextractor becomes obvious at signal to noise ratios larger than 10.

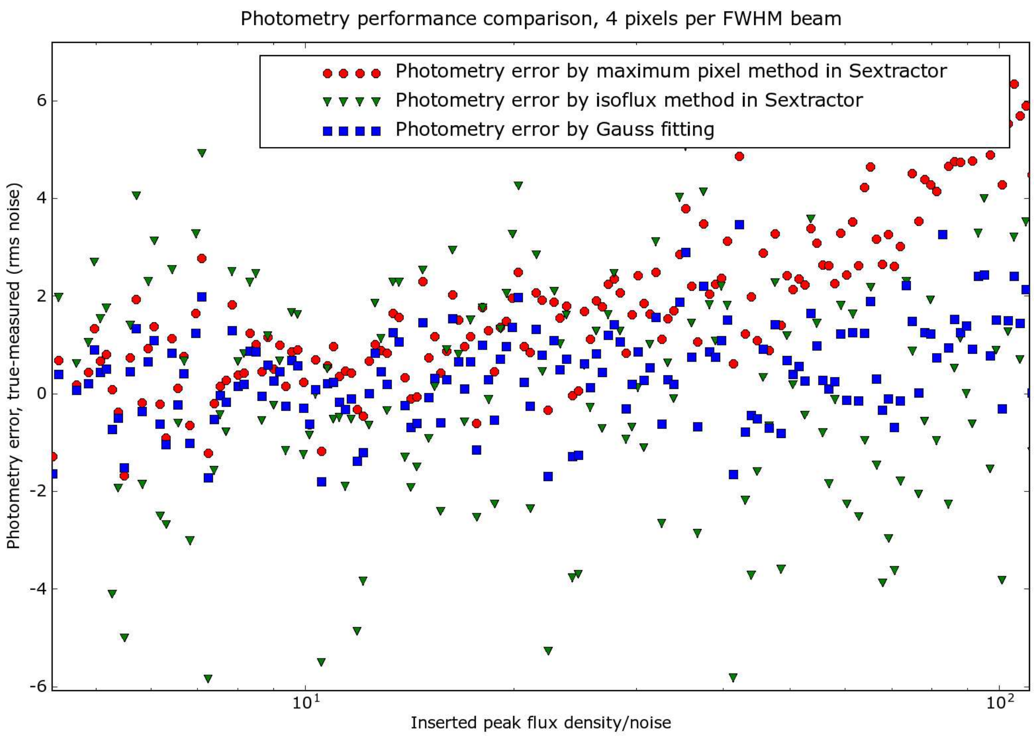

Figure 4: This plot provides a more detailed view of the photometry performances. The isoflux method in Sextractor does not have a systematic error, but the standard deviation is larger than the rms noise, so both photometry methods in Sextractor do not provide the optimum precision.

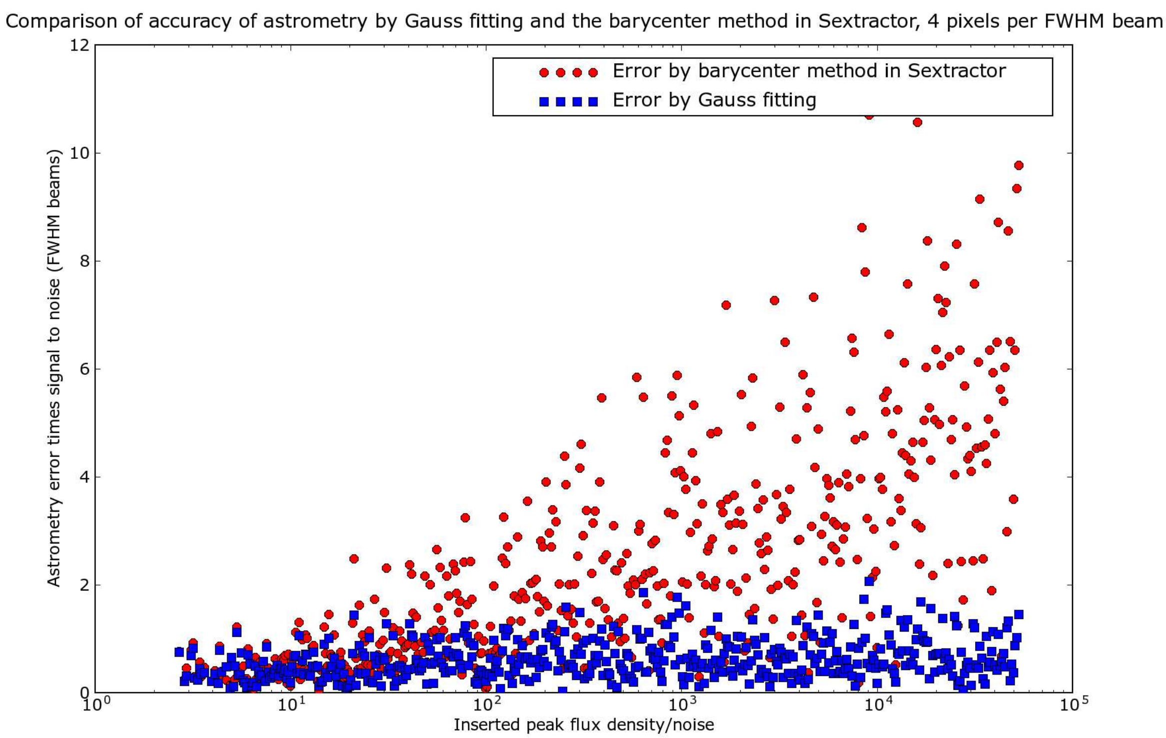

Figure 5: There is no systematic error by Sextractor astrometry, which uses the barycenter method, but its accuracy does not increase as steep as the beamsize divided by the signal to noise.