CUPID - A 3D Clump Identification and Analysis Package

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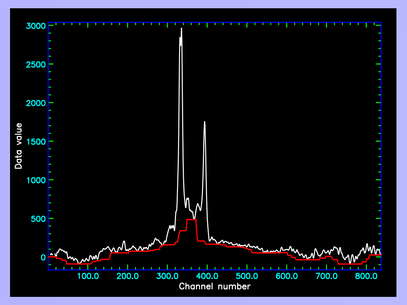
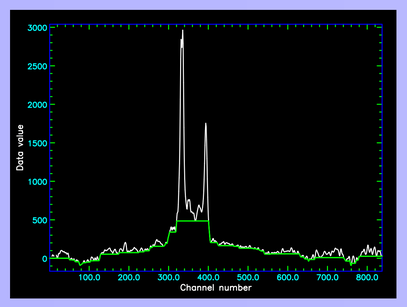
Min-Max Background Estimation:

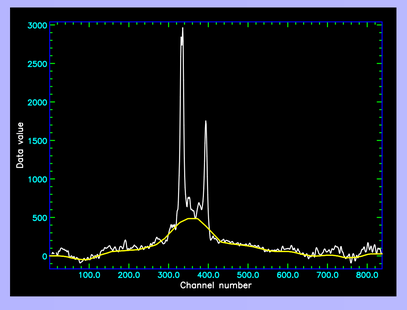
Step 1: Each data value is replaced by the minimum value in a box centred on the value being replaced. The red curve above is the result of filtering the white curve in this way with a box size of 59 channels.



Step 2: Each value produced by step 1 is replaced by the maximum value in a box centred on the value being replaced. The green curve above is the result of filtering the red curve from step 1 in this way (box size is again 59 channels).



Step 3: Each value produced by step 2 is replaced by the mean value in a box centred on the value being replaced. The yellow curve above is the result of filtering the green curve from step 2 (box size = 59 channels). A final correction is applied to counter the tendency to hug the lower envelope of the noise, and the result is the final background curve.

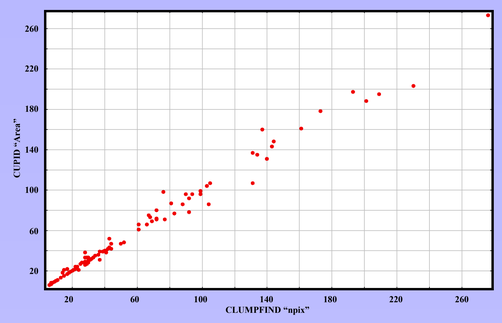


CUPID:

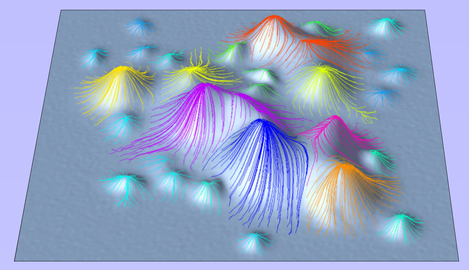
- A package of commands that allows the identification and analysis of clumps of emission within 1, 2 or 3 dimensional data arrays.
- Is being developed by the Joint Astronomy Centre (JAC), Hawaii, as part of the SCUBA-2 and HARP advanced data products survey pipelines, using funding from PPARC.
- Can be used on any regularly gridded 1, 2 or 3 dimensional data, but is targeted primarily at sub-mm cubes.
- The FINDBACK command estimates the background at every pixel in an array, using a "min-max" filter (illustrated in the left hand panel) to remove features below a specified scale size.
- The FINDCLUMPS command identifies and de-blends clumps in the background-subtracted data using one of several supported methods. These include the established GAUSSCLUMPS and CLUMPFIND algorithms, together with two new algorithms called REINHOLD and FELLWALKER developed specifically for CUPID . Other algorithms can be added as needed.
- The results of all clump finding methods are presented in a consistent manner to facilitate inter-comparison of the different methods. The data products include masks identifying the pixels that contribute to each clump, and catalogues holding clump positions, sizes, peak values and integrated fluxes.
- Integrates with the UK Starlink Software Collection (now being maintained by JAC following the end of the Starlink Project) but can be used transparently on FITS data by means of the Starlink CONVERT package.
- Further information available at:

  http://www.starlink.ac.uk/~dsb/cupid

Clump Finding Algorithms:



A comparison between the CUPID implementation of the CLUMPFIND algorithm and the IDL implementation available from `http://www.ifa.hawaii.edu/~jpw`. The X and Y axes shows the clump volumes found by the CUPID and the IDL implementation respectively, for a crowded 3-D data array. The CUPID implementation is more than an order of magnitude faster than the IDL implementation.



The FELLWALKER algorithm is a new alternative to CLUMPFIND. It steps through all pixels with value above a specified threshold, and for each one walks up a line of steepest gradient starting at the pixel until a local maximum is reached. A search is then made for a higher pixel value in a small neighbourhood centred on the peak. If a higher value is found, the algorithm jumps to that pixel and continues up-hill. When a maximum is found that is higher than all pixels in its neighbourhood, it is designated as a clump peak, and all pixels traversed in the up-hill walk are assigned to the clump. If a walk reaches a pixel that has already been assigned to a clump, then all pixels on the walk so far are assigned to the same clump.

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