

Gaussian Gradient Filtering

Carter Rhea

October 15, 2019

1 The Why

We have the ability to create magnificent astronomical images by borrowing a few techniques from the image processing community. Here we use a technique called gaussian gradient filtering (GGF) to highlight regions in a galaxy cluster. GGF is fantastic at pulling out high contour regions such as shocks, but fails to adequately mark X-ray cavities in certain cases. For those, I suggest using a more standard method such as beta-subtraction or unsharp masks.

2 The Basic Algorithm

GGF works by convolving the derivative of a gaussian with a signature σ value. That's really it! We use `scipy.ndimage.gaussian_gradient_magnitude` to do just this. We also allow the user to define a series of sigma values, weights, and concentric regions to create a final combined image of several different σ -values.

1. Create a mask for each image based on the annuli and weight
2. Add weighted images together for each bin
3. Reconstruct complete weighted image by recombining weighted, binned image

Practical Note: The image files all need to be the same size and of the same region!

In addition to creating a final combined image, we also create a fits image file for each sigma value. The individual imports (and their description) can be found in the source code.