Average of optimized interferometric PSF.

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As has been pointed out by several people, you don't really want positive average interferometric PSF sidelobes near the beam center. The last sentence of the first paragraph of section V. of ALMA memo #390 is wrong and should be ignored, but the concept of how to drive the array towards having a reasonable distribution of short baselines works.

It was noticed that the PSF peak minimization algorithm I was using in ALMA memo #390 did not produce many short baselines. In fact, you can produce very small near sidelobes and not have any short baselines. The remedy I tried was to give the algorithm a non-zero goal for the PSF. The sequential optimization was given a goal of 2.5% sidelobes including the single dish data, equivalent to 0.9% for the interferometric PSF. The algorithm is driven off the peak deviation of the net PSF (including single dish data) from the goal. The goal of 2.5% was used to try to get the average of the interferometric PSF close to zero in the near-in sidelobes. The interferometric peaks do not have a symmetric distribution about zero (the max negative level is –1/(N-1) ref. Kogan while the positive peaks can be large) and this complicates trying to drive the average to a predetermined value by working on the peaks. So the positive PSF goal was just a trick to try to get my simple algorithm to move towards the real goal of an average of zero for the interferometric near sidelobes. Fig. 1 shows the results of this procedure. It worked reasonably well but still left a slight >0 average within 10 synthesized beam widths of the center as shown below. This can be corrected by adjusting the goal downward by ~0.2%.

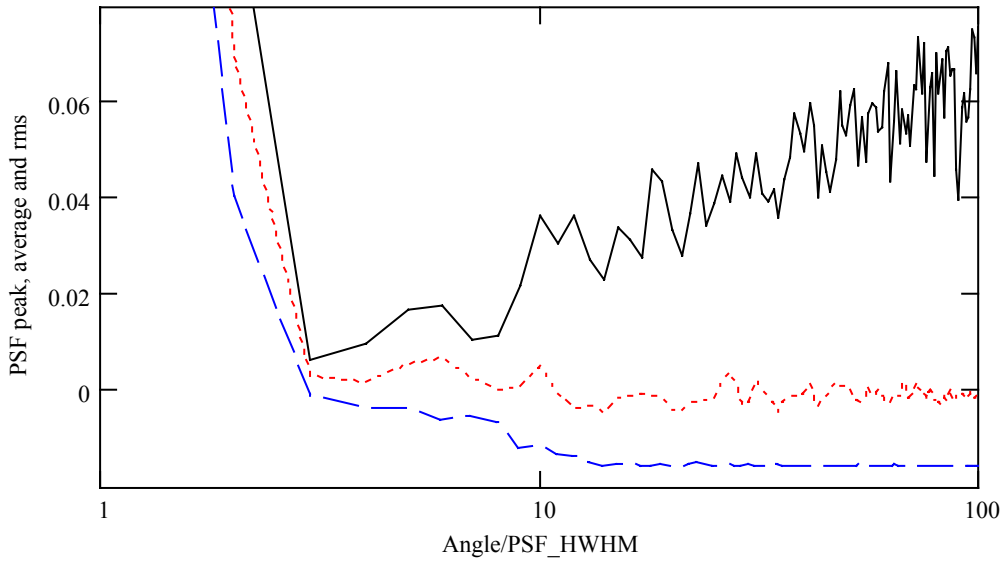

Fig. 1. Radial plot of the peak (solid black), average (dotted red) and minimum (dashed blue) PSF sidelobes for the array in Fig. 14 of ALMA memo #390. The single dish contribution has been removed to show the interferometric PSF.

I believe a similar problem will occur in algorithms working on the UV distribution, such as the one developed by Boone. The UV density at the center of a Gaussian distribution for the largest configurations will be less than one sample per antenna area. Thus the algorithm will not tend to drive towards having short baselines. This can be corrected by adding a peak to the target distribution at U=V=0. The amplitude and width of this peak will need to be adjusted to achieve the desired zero average interferometric PSF near the beam center.