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To: Holographers

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Subject: Improved gridding algorithm

Introduction

Brian Corey has pointed out the need for more accurate coordinate transformation in holography (see his memo dated 4 April 1991). Rich Barvainis applied the correction and found that the symmetry of the maps improved - but the fit in HMAP was degraded. John Ball pointed out that the gridding in HMAP was probably too simple.

HMAP reviewed

HMAP performs the following Gerchburg iterative image reconstruction:

1] MODEL FOR ANTENNA A(X,Y) (initially zero)
2] DERIVE MODEL BEAM AT MEASURED POINTS $M_K(U_K,V_K)$ (by direct transform)
3] GRID THE DIFFERENCE BETWEEN DATA and MODEL INTO DIFF(U,V)
4] ADD DIFFERENCE TO MODEL AT GRID POINTS AND TRANSFORM
5] GO TO 1

$$M_K(U_K,V_K) \xleftarrow{DFT\ OR\ ZOOM} A(X,Y)$$

$$DIFF(U,V) = \sum \left(D_K\,(U_K,V_K) - M_K\,(U_K,V_K)\right) / NUM(U,V)$$

all points with U,V cell

$$A(X,Y) \xrightarrow{FFT} M\,(U,V)$$

$$M(U,V) = M(U,V) + DIFF(U,V)$$

$$M(U,V) \xrightarrow{FFT} A(X,Y)$$

New gridding method

In the new gridding method each difference is gridded into 9 UV cells (rather than one) with a weight of (1 - D) for D < 1 and zero otherwise

where

D = distance from measured U,V point to center of the UV cell in units of cells.

The gridded differences are then normalized by dividing by the sum of all the weights within a cell.

How are the results affected by the gridding?

If the method converges and there are no unsampled cells the old and new methods are about the same. The new method appears to work well because previously unfilled cells are now filled with weighted difference. I have the impression that a more sophisticated gridding interpolation would not further improve the results - unless there are still some unfilled cells.