APPLICATION OF THE SIMPLEX ALGORITHM TO IMAGE RESTORATION

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ABSTRACT

The data measured by an interferometer define the original image through linear equations of constraint containing the Fourier coefficients. These constraints and the requirement that all image points show a non-negative flux define a problem frequently encountered in operations research and numerically tractable through the Simplex Algorithm. When the data are undersampled, a continuum of original images is compatible with the measured points. The advantage of the operations research method in this situation is that the continuum of restorations is generated rather than a single example. As a practical matter, it appears most useful to select from this continuum the maximum sharpness restoration - which like CLEAN uses reasonable a priori information to chose one of the possibilities - and to select for comparison the maximum entropy solution - which embodies diametrically opposed a priori information. The first may be considered the best restoration for an astronomical source, while the second indicates the uncertainty due to undersampling. When our astrophysical deductions depend strongly on the restored structure of a source, a comparison of alternative solutions is necessary to acquire confidence in the deductions. The maximum sharpness solutions also have the advantage that small phase errors in the measured complex points can be compensated. In principle, large phase errors can be compensated, but uniqueness may be lost, and existing numerical procedures for this case are inefficient.

C. van Schooneveld (ed.), Image Formation from Coherence Functions in Astronomy, 291.