FROM 2-D TO 3-D BY MAXIMUM ENTROPY METHOD

Ofer Lahav and Donald Lynden-Bell
Institute of Astronomy, Madingley Road, Cambridge CB3 0HA, UK

Steve F. Gull
Mullard Radio Astronomy Observatory, Cavendish Laboratory, Madingley Road, Cambridge CB3 0HE, UK

We present a method of estimating distances to clusters of galaxies from two-dimensional catalogues. The angular diameters (or magnitudes) of galaxies are used as distance indicators. The mapping from 2-D to 3-D is done by using a 'diameter function' (analogous to a luminosity function), which is based on a redshift survey from a section of the sky. The problem is formulated as follows. The number of galaxies with a metric diameter D in a volume element d^3r is:

$$dN = n(\mathbf{r})/n_b \; d^3r \; \phi(D)dD \qquad 1$$

where n($\mathbf{r}$) is the 'true' number density of galaxies at position $\mathbf{r}$, n_b is the mean number density of galaxies in the universe and $\phi(D)dD$ is the diameter function. We assume that within a narrow cone n($\mathbf{r}$) = n(r) and then express $N(>\theta)$, the number of galaxies greater than a certain angular diameter θ. In a discrete form we write the relation as:

$$N(>\theta_k) = \sum_i n_i P_{ik} \qquad 2$$

where n_i is the density at the $i-th$ distance bin and P_{ik} is our 'point spread function', which is a function of the diameter function and Galactic obscuration. We express (2) in terms of χ^2 statistics over the measurements, and require it to be less than a certain value. The **entropy** of the image is expressed as :

$$S = \sum_i [n_i - n_b - n_i \; log(n_i/n_b)] \qquad 3$$

The procedure now is to maximaize the entropy (3) under the χ^2 constraint. As an example we have applied the method to galaxies from the UGC catalogue which are within 6 degrees of Virgo's centre . The algorithm identifies a strong peak at a distance of about 1500 km/sec and a secondary peak at about 6000 km/sec. This secondary peak is an extension from the Coma cluster, as seen on redshift maps.

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