A Method for the Assessment of the Fish Abundance

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The aim of this paper is to illustrate a first application of a method based on K-nearest neighbour theory in order to assess the density of fish populations.

The assessment of the abundance of the marine Resourches, in the last years, is becaming every more important and pressing either for the management of fisheries activities or for environmental reasons (LEVI AND ANDREOLI, 1989).

The examined geographic area is considered as digital image in which high intensity zones (i.e. high measures of biomass realized by means of elettroacustic methods or by means of trawl surveys) correspond to high density zones in the binary image.

In the following, binary image are considered and the pixels with value equal to 1 are named "on" pixels; these pixels represent both structures background and "signal". Such images are referred as sparse images (DI GESU' , 1987); their analysis mainly deals with the densities of the "on" pixels instead of their intensities. Sparse images are kind of data often detected and analysed in biomedicine, high energy physics, X- γ-Astronomy.

Our method is directly comparable to the classical formulation of the deconvolution problem in the instance of discrete image, without noise background, v; namely it may be stated as follows: "given an image, M, detected by an instrument with response function, R, recover the true one, T".

Formally, the problem corresponds to finding the solutions of the vector equation:

$$M = R (*) T + v$$

where the operator (*) is the convolution product. Often its exact analytical solution is difficult or impossible (TIKHNOV and AESENINE, 1974) because only statistical hypothesis may be done on the noise part, the response function is not well known and the linearity assumption is far from reality.

The proposed adaptive convolution technique uses the local density information to compute the parameters of the convolution Kernel. At the present three convolution kernels have been considered. The gaussian (G), the uniform (U) and the Triangular (T). Their statistical parameters (bariances, width, ...) are determined by considering the K-nearest neighbours of each on-pixel.

There are several methods for the computation of the response function, R, and its shape parameters. The problem of computing the local density has no exact solution and anly heuristic methods have been proposed in the literature (TOUSSAINT, 1982, FRIEDMAN ET AL., 1981). Two major problems must be addressed: the choise of the best number of sample points and the evaluation of the "real" area in which they are contained.

The method has been tested on simulated data in order to control the results. The simulation technique generates a binary image, the density of which is proportional to the intensities of input image. The experimental results point out that the method restores the form of original images with good approximation.

THe method will be applied an real data collected during eight trawl-surveys in the sicilian channel and by employing a stratified random sampling design.

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