



# United States Patent [19]

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Carasso

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- [54] **PROCEDURE FOR DIGITAL IMAGE RESTORATION**
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- [58] Field of Search ..... **382/6, 54, 42; 364/413.13, 413.17, 413.19, 822**

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[57] **ABSTRACT**

The image restoration system and method of the present invention is applied to point spread functions  $p(x,y)$  which may be described in the Fourier domain as

$$p(\xi, \eta) = \exp\{-\sum_{i=1}^N \lambda_i (\xi^2 + \eta^2)^{\beta_i}\}, \lambda_i \geq 0, 0 < \beta_i \leq 1,$$

to improve noise performance and permit identification of fine detail. The novel method formulates the image restoration problem as a problem in the partial differential equations describing diffusion phenomena using a new type of a priori constraint. The restored image is obtained by minimizing a quadratic functional incorporating this new constraint. The solution of the minimization problem may be obtained directly by means of fast Fourier transform algorithms. The restoration method may be performed as a sequence of partial restorations as  $t \downarrow 0$  wherein the partial restorations become sharper and noisier as  $t \downarrow 0$ , or as a single full restoration. The sequence of partial restorations may reveal features of the image before such features become obscured by noise and may permit adjustment of the parameters characterizing the blurring functions and constraints.

**12 Claims, 3 Drawing Sheets**

