

recording means supplying 2D projections in digitized form of the sample and forwarding the data contained in them to the calculation means in order to provide a 3D image reconstruction, characterized by processing said data with the use of an approximation that the smearing function is greater than zero only for a limited number of grid points in a layer perpendicular to the beam direction and in producing the 3D structure whose projection convoluted with the point spread function will adapt to the observed structure.

9. A method according to claim 1 for a 3D reconstruction of a sample, characterized in that said observations of the sample are a series of differently tilted 2D observations of the sample.

10. A method according to claim 1 for a 3D reconstruction of a sample by means of light recordings, characterized in that said observations from different aspects of the sample are a series of 2D observations focused at different depths of the sample.

11. A method according to claim 1, characterized in that the reconstruction is provided of organic objects, for instance small organic objects, such as virus particles or the like.

12. A method according to claim 1, characterized in that the reconstruction is a pattern reconstruction of sample elements (51) having slightly different designs provided on a card (50) in order to provide a secure and unique identity of the card.

13. A method according to claim 1 for a 2D reconstruction, characterized in that the different aspects of the sample are lines across the sample.

14. An apparatus for providing high fidelity reconstruction of an observed sample of an object built on a grid having determined grid points, said apparatus comprising:

input means (10, 11, 13, 14; 40, 43, 14; 52, 13, 14) providing observed data of the sample;

estimated distribution means (19; 44; 54) providing an initial estimated density distribution of the sample on the individual grid points;

prejudice distribution means (21, 25, 15; 45, 15; 54, 15) providing a blurred prior prejudice density distribution on the individual grid points using estimated data;

calculating means (12), cooperating with said sample observation means, estimated distribution means and prejudice distribution means, for calculating in an iterative process for each iteration:

a new estimated density distribution of the sample on the grid points using the prior prejudice density distribution and comparison between the estimated density distribution in the next preceding iteration and said observed data of the sample from said input means,

a new prior prejudice density distribution on the individual grid points on the new estimate less blurred than the prior prejudice distribution in the next preceding iteration;

said calculation means (12) is adapted to continue the iterations until the difference between the new estimated density distribution and the next preceding estimated density distribution is less than a predetermined condition; and means (16; 46; 57) connected to said calculation means for presenting the calculated result.

15. An apparatus according to claim 14, in which said input means (10, 11) measures several aspects of a quantity (1), characterized by

means for providing a variance for individual observation grid points in each recorded observation;

said calculation means (12) for each iteration cycle provides the following calculations:

a new prior prejudice distribution,

an entropy (S) using the immediately preceding calculated reconstruction and the new prior prejudice distribution,

a reduced chi-squared statistic (C) using the immediately preceding calculated

reconstruction, the observed data of the sample, said variance, and said grid, while maintaining normalization of the calculated reconstruction, under the constraint of maximising the entropy relative to the prior prejudice while driving the reduced chi-squared statistic towards +1 and maintaining normalization, and providing a new calculated reconstruction to use in the next iteration cycle.

16. An apparatus according to claim 15, characterized by means (18; 42; 53) feeding a point spread function of the input means, being a convolution, to said calculation means;

said calculation means (12) calculating a projected point spread function, called a smearing function, being greater than zero only for a limited number of grid points of said sample and producing a 3D structure whose projections convoluted with the point spread function will adapt to the observed structure.

17. An apparatus according to claim 16, wherein the input means comprises a device (10; 52) supplying observed data of 2D projections in digitized form of the observed sample and forwarding the data to the calculation means in order to provide a high fidelity 3D image reconstruction, characterized in that said calculation means processes the data with the use of an approximation that said projected point spread function is greater than zero only for a limited number of grid points in a layer perpendicular to the beam direction and producing the 3D structure whose projections convoluted with the point spread function will adapt to the observed structure.

18. An apparatus according to claim 14, characterized in that said input means is a microscope, for instance an electron microscope, a light microscope, or a confocal microscope.

19. An apparatus according to claim 14, characterized in that said input means is a card reader (52) reading a pattern of sample elements (51) having slightly different designs provided on a card (50) in order to provide a pattern reconstruction for providing a secure and unique identity of the card.

20. An apparatus according to claim 14 for a 2D reconstruction, characterized in that said input means is a scanning device (40) scanning a 2D image; and that said projections are lines across the sample.

21. An apparatus according to claim 14, characterized in that the input means (52, 13, 14) records variation of the quantity in relation to a predetermined variable and the calculation means reconstructs the measured quantity as a series of measurement data.

22. An apparatus according to claim 14, characterized in that the estimated and the prejudice distribution means are working on an output envelope from an object to be observed, the envelope being the sample to be reconstructed; and that the estimated and the prejudice distribution means regard the rest of the object as a buffer to be reproduced from iteration to iteration without reconstruction.