Abstract of
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This dissertation presents work on the Geometric Superresolution. There are two main parameters that can affect Geometric Superresolution, the finite size of pixels and the pitch of the pixels in digital imaging device like CCD (charged coupled device). In superresolution systems, the ultimate limit to resolution generally comes from the Geometric and not from the optical part of an imaging system. This thesis mainly deals with the undersampling of an optical image in which the separation between the neighbouring pixels in a CCD is assumed to be greater than the separation required by Nyquist Sampling.

The problem of undersampling an optical image has been dealt with the use of an optical mask placed at the Fourier transform plane in a coherent 4f imaging system. The one dimensional version of the optical mask consists of a 1-dimensional amplitude grating. The optical mask is used to sample the Fourier transform of the input object. Due to the sampled Fourier transform, the image plane contains replicas of the input object. A CCD is used to undersample these replicas. The recorded under-sampled image is Fourier transformed and contains replicas of original object spectrum but overlapped due to the under-sampled image recorded by CCD. The overlapped spectrum is multiplied with a soft copy of an optical mask which removes the overlapping by removing the neighbouring spectral copies. An interpolation is done on the recovered single object spectral copy to fill the holes in the spectrum. The resultant spectrum is then Fourier transformed to obtain an image free of artefacts and free of undersampling effects.

Different analogues of optical masks and CCD pixels have been presented and discussed in this thesis. Optical masks may consist of negligibly small line widths or lines with finite widths. Similarly, an ideal CCD may consist of point pixels in which the pixel size is negligible in comparison with the spacing between them or in real situations may have finite size. The effects of these parameters on Geometric Superresolution have been discussed in the thesis. Simulation results in one and two dimensional have been presented to support the idea.

A part of the thesis also discusses a technique dealing with subpixeling. An optical image usinga Spatial light modulator is projected on a CCD and shifted in sub-pixel steps. The retrieved data corresponding to each sub-pixel step is combined to obtain high resolution image. This has been supported with experimental verification.