FAST-FOURIER-TRANSFORM FOR TILTED PLANES BASED ON NUMERICAL INTEGRATION

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MOTIVATION

In reflection Confocal Microscopy (CM), enhancement of the scanning rate has been a point of interest to research for decades. Nowadays, real-time measurements with confocal microscopes are possible using faster computers with several scanning techniques, i.e., real-time scanning with a Nipkow disk. Nonetheless, there is still an effort trying to invent a scanning method with less mechanical parts, i.e., chromatic sensors which invoke dispersive optics at different wavelengths to focus at different depths. This work, therefore, is motivated by a novel concept of a Confocal Line Sensor (CLS) [1]. The novel concept of a CLS makes use of a tilted plane of pinhole apertures to form a tilted sharp focal plane. It is fundamentally similar to focal points focused at different depths as can be seen in a chromatic sensor, but with less complication. One concern is the resolution which can be achived by a CLS. Typically, the resolution is referred to the intensity distribution at a focal point or the so called optical resolution. This work, therefore, studies on free space diffraction for a tilted aperture plane.

FFT FOR TILTED PLANES

The numerical diffraction calculation has gained benefit of fast calculation by applying the fast Fourier transform (FFT) algorithm. However, the FFT is enable to calculate the complex amplitude of diffracted waves on a plane parallel to the aperture [2]. In the case of tilted plane, the FFT technique of plane wave propagation applied with coordinate rotation has been reported by Matsuhima, et al. [3]. Therefore, this research work presents a technique of calculating the diffracted waves by the FFT techniques based on numerical integration and coordinate rotation for the tilted planes. The method is based on Rayleigh-Sommerfeld diffraction integral. Nonetheless, the sampling interval in FFT calculation for the tilted case has not been explicitly clarified in the literature. To clarify more on that, a sampling interval is discussed according to Nyquist sampling theorem. Finally, simulation and experimental results are compared to certify the method.

REFERENCES

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