Properties of fourier intensity filter for optical diferentiation

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Abstrak

Optical differentiation is one of many methods in the optical data processing that is useful for, e.g. image contouring. In this thesis, the differentiation filter is caried out based on the spatial filtering techniques. The ob ject is transformed with a Fourier lens to obtain the spatial frequency spectrum of the object at the Fourier plane. A spatial differentiation filter is placed at the Fourier plane. And finally, with another lens the filtered spectrum is transformed back to obtain the output image.

The critical step of the experiment is the design and the fabrication of the filter. In this thesis, two kinds of models have been used to approximate the differentiation filters: (1) multi-step function and (2) Gaussian spot. The multi-step function is intended to approximate the first order differentiation filter. However, due to the photographic limitations, the multi-step function has become a single step function or simply a high-pass filter. Nevertheless, the result may be useful as the approximation of the second (not the first) order differentiation. A filter with a diameter of 0.4 mm appears to give a good result for an object consisting of letters of 4 mm high.

To obtain the Gaussian spot, a He-Ne laser beam spot with 6328 nm has been used. with several attenuations, the laser beam spot has been recorded with various shutter speeds in an open camera. It appear that the Gaussian filter is a very good approximation of the second order differentiation filter. Compared to the high-pass filter, it gives higher S/N ratio. The Gaussian spot obtained with a shutter speed of 1/4000 and minimum attenuation gives the best image output. However, none of the filters gives the first order differentiation output.