* TALK ABOUT RESEARCH :
* - GRAYSCALE IMAGE FORMATION USING PROGRAMMABLE BINARY MASK.
* In the recent publication of the optical engineering, we present a laser image formation produced by DLP chip, which can be imagined as an binary mask.
* The system uses a DLP 4100 to serve as a binary mask, followed by a telescope with a pinhole located at the focal length of the lens after DMD. The idea of the system, at the beginning, focus on displaying static image with high degree of uniformity. Therefore, instead of dithering approach, to produce a gray-scale image, it applied the half-tone algorithm, that can create gray scale image to human eye using only black and white pixel. The gray level being, will be determined by the density of black pixel or white pixel. Instead of addressing the gray-scale in time multiplexing, this system approach this task spatially.
* However, through only the half-tone binary image, although it can create smooth image to human eye, which has built in low pass filter, the real image, formed after the lens is spatially not smooth, which I can see lots of jumping around edges, and that’s the result of containing high frequency component. Thus, the lPF, is cooperated into the system, in order to smear out the pixel image, from square profile into a more Gaussian like profile. This, is done using the MATLAB to simulate the first binary pattern. Second when the real image is acquired through the camera lens, the environmental or the system noise needs to be accounted for. So, the first image acquired, is feeding back to compare with the ideal gray-scale image, and see the difference between them. The locally intensity difference is filled through the change of pixel status. If a peak is shown, the corresponded pixel and surrounding will be turned off, and vice versa. This constructed this gray-scale image system.
* Zero – Order Diffraction Eimilination
* The motivation of this research first begins from the review question of the previous proposed algorithm. The problem statements is, consider we have a holographic image through a phase-only spatial light modulator, how do I resolve the zero-order diffraction in a near-field zone? This reason, that the ZOD being kicked off results from the spread function shape in the near field. Therefore, you can imaging when projecting a holographic image, a un-diffracted, aperture-like square pattern will pinned on the center of the image plane. And this can result a limitation of image display area, sometimes, when holographic microscopy was used in the system , the strong, spread light source, will destroy the image, and affecting the accuracy.
* Some of the paper, address this through hard-ware approach, which directly block the light source, but might increase optical component in the system.
* Others, approach this system from software approach, which, it is claimed that it is possible to create a same zero-order diffraction functions at the image plane, as long as we added this into the initial design of holographic image pattern.
* In practical, this is not only computational heavy, but also less practical. Because the involved zero-order diffraction, is complicated, and hard to duplicated.
* Thus, I started from the investigation of this holographic image formation, to form a mathematical description of the system, in near-field, and purposed that we can view this point of view form the far-field region. Consider, we have a ideal system, which the image is not affected by the device aperture. The un-diffracted light, can be considered as a delta function, at far-field, and thus, if I can generated another delta function with opposite phase, then I can eliminate the ZOD. Therefore, we uses a post-algorithm, to compress the phase that is used to generate the holographic image. By compress the full spectrum, from 0 – 2pi, into a certain range. Such as 0 – 2\*c\*pi; You will be able to generate a peak, in the fourier domain, which is your far-field.
* And we can think that when light, propagate back to the near-field region, the ZOD doesn’t exist. Because the near-field image, is only a convolution of far-field image with a phase kernel.
* This approach has doesn’t involved in any predesign of the holographic image, thus, when the realistic ZOD is not eimilinate totally, only the scale factor, c needs to be changed, instead of calculation of the full phase pattern. This become very efficient in computational apesct.
* Then I create the system, analysis the image tolerance, as well as the distortion
* PLEASE DESCRIBE YOURSELF:
* WHAT KIND OF OPTICAL SYSTEM YOU’VE DONE
* - I’ve done several projects related to the optical system, my first exposure to optical system is when I graduated from college, I worked in Academic Sinica as a research assistant there. The projects is to develop a optical system that modulate phase of light, but maintain high resolution phase modulation, and collimation of light source. This project was done by stack two prism together in the opposite, using stepping motor to push the prism in 10nm stepping resolution. From where I learnt to how to alignment optics and testing the system. Have their bevel edge faced together,
* When I joined UT, I was requested to be responsible for three projects, these projects are related to each have different purpose. First projects involves to purpose the solution to resolve the near-field zero order diffraction in phase only holographic display. This system, has its challenge that the method, purposed, needs to be first computational efficient, because the calculation for a phase hologram is time-consuming. Second, near-field ZOD is a complicate function, that spread over the center of image, to suppress it totally, requires sophisticated tailor of the design pattern, thus cast difficulty. Last, the purpose method, needs to be insensitive of the device aperture, which, shape the ZOD function in a convolution way. Thus, I uses a post process algorithm, to squeeze the phase hologram, in order to produce additional cancellation ZOD without painful way. And it is experimentally proved that the suppression ratio, reaches over 70% of unsuppressed pattern, some of the ratio, comes from light source incompatible of device window.
* I started to get involve with DLP design, when I tried to adopt DLP in the holographic system. The reason is that it’s fast process speed, can be a strong advantage in image projection, and its stabilized in status 0 and 1, compared to phase modulation, which varies in 60 Hz, it much more stable.
* But, the problems also results from here. If we consider DLP as a binary mask, in the holographic display, where the image reconstruction happens in the fourier domain of the DLP mask, and that gives you a strong , centered light, in far-field, and a aperture-shpaed function, in near field. So, same old problem, we got zero order diffraction here, but we don’t have any phase to manipulate with. In order to solve the problem, I designed a two-beam incidence DLP interferometer, where DLP is illuminated by two incident beam from + direction, to shine on on-pixels, and the others from – direction, to shine on off pixel. The symmetry structure, is proved mathematically, to have no even order. This is like, the binary mask, is encoding from 0-1 to -1 and 1. And the suppression ratio of the zod, also achieve over 70% experimentally.
* At the same time, I continued the works of my co-work, who proposed the beam shaping system through DLP. We uses half-tone to encode the binary mask in DLP, and a low pass filter to
* My career objective is to work, as application-based