



**CALIFORNIA STATE SCIENCE FAIR
2012 PROJECT SUMMARY**

Name(s) Jett D. Liu	Project Number J1414
Project Title Investigating Properties of Computer Generated Holograms	
Abstract Objectives/Goals Last year, when I was in sixth grade, I created holograms by capturing interference fringes onto a holographic plate using a laser. This year I wanted to find out if it was possible to create holograms without using an object or a plate. I decided to try to generate and print hologram patterns using a mathematical computer program. I tested the distributive property of holograms and the effect of print resolution on these holograms, measured in dots per square inch (dpi). Methods/Materials I tested a total of seventeen holograms, ten at 300 dpi, seven at 600 dpi. I used a computer program to create these holograms. The program uses a mathematical method called the Fourier transform to calculate the depth of the hologram and create the interference pattern of the hologram. I printed out the holograms I created onto transparency film. I then used a laser to view the holograms. This project required a HeNe laser, and transparency sheets. Results Of the seventeen holograms I created and tested, the 600 dpi images were considerably more detailed when viewed and the shapes were clearer. I also tested the distributive property of holograms. I tested what 50% of the hologram covered would produce, and I also tested the image at 95% concealment. There were no obvious differences between the two tests and the original hologram. Conclusions/Discussion As I conducted my experiments I realized that the holographic patterns were similar to Quick Response codes (QR codes), which are being used instead of UPC barcodes for some products. I believe that computer generated holograms can be used as a replacement for QR codes. Not only because holograms can be read faster, but because they contain more information, and can be read even if the hologram is damaged. Holographic computer storage is also something that I believe should be the trend for the future. Currently the prototypes can hold up to 1.6 terabytes of data, which no existing computer can compare to, and not only that, all 1.6 terabytes can be read in less than 0.5 seconds. Also, due to the distributive property, if the storage medium is damaged the data is not lost, and can still be read. Holographic storage, I believe, will be the hard drive of computers of the future.	
Summary Statement I investigated the properties of holograms and the interference patterns that were generated by a computer program, using the Fourier transform.	
Help Received Thanks to my father for purchasing the test materials and supervising me during the experiments. Thanks to my science teacher for loaning me lasers. Finally, thanks to my math teacher who taught me the Fourier transform.	