



**CALIFORNIA STATE SCIENCE FAIR  
2002 PROJECT SUMMARY**

<b>Name(s)</b> <b>Ray Ramirez</b>	<b>Project Number</b> <b>S0714</b>
<b>Project Title</b> <b>High-Density Holographic Data Storage Utilizing High-Resolution Silver-Halide Media</b>	
<p style="text-align: center;"><b>Abstract</b></p> <p><b>Objectives/Goals</b> The project had three objectives. First, to establish the parameters of Slavich PFG-01 emulsion. Secondly, to establish linear and volumetric data storage, thereby increasing the density of the data stored within that area. The third objective was to retrieve the stored data via a laser diode, and transfer such data, via a charge-coupled device (CCD) into a digital environment.</p> <p><b>Methods/Materials</b> Emulsion parameters were established by exposing a series of six holograms. In each exposure, the percentage of TEA (Triethanolomine) was varied. To accomplish linear data storage, an opto-mechanical setup, based upon a 36"x12" breadboard, was designed. The setup utilized a Fourier Transform to reduce the imagery (35mm slides) to 1mm<sup>2</sup>. The holographic plate was mounted on an XYZ translator. Six exposures were made into a 2.5in.<sup>2</sup> plate. After each exposure, the X-axis was translated 1mm. To establish volumetric data storage, the translator was rotated on it's center axis in six, 16 (degree) increments. To reconstruct the data, a laser diode recreated the reference angle used to store the image. The data projected onto a diffusing screen, where a CCD forwarded the image to a computer.</p> <p><b>Results</b> It was observed, plates, which were not presensitized with TEA, yielded the highest diffraction efficiency, satisfying objective one. Linear data storage was successfully established by storing six, 35mm, images in an area 6mm x 1mm. Six images were stored in a 1mm<sup>2</sup> area, successfully establishing volumetric data storage. A limiting phenomenon was observed during volumetric storage tests. In creating a data retrieval system, a laser diode proved powerful enough to retrieve and project the stored images. Stored data (linear and volumetric) that was successfully retrieved was forwarded to a computer system utilizing a CCD.</p> <p><b>Conclusions/Discussion</b> The incorporation of the CCD, allowed for the demonstration of a working holographic hard drive. The phenomenon of "cross talk" observed during reconstruction, is a physical limitation of holography and causes the integrity of the data to be compromised. Further development points in the direction of holographic optical elements (H.O.E), which would replace complex optics in the system. By incorporating H.O.Es, a holographic data storage unit could theoretically fit well within the confines of the personal computer.</p>	
<b>Summary Statement</b> The project goal was to design and construct a holographic data storage system utilizing silver-halide media and retrieve data therefrom.	
<b>Help Received</b> Used lab at PCC; Prof. Unterseher provided procedural consultation	