

## TERABYTE OPTICAL DATA STORAGE

P Török<sup>1</sup>, PRT Munro<sup>1</sup>, M. Salt<sup>2</sup>, HP Herzig<sup>2</sup>, E. Kriezis<sup>3</sup>, B Eastley<sup>1</sup>

<sup>1</sup>Imperial College, Blackett Laboratory, Prince Consort Rd, London SW7 2BW, UK

<sup>2</sup>Institute of Microtechnology, University of Neuchâtel,  
Rue A.-L. Breguet 2, CH-2000 Neuchâtel, Switzerland

<sup>3</sup>Aristotle University of Thessaloniki, Dept. of Electrical and Computer Engineering  
Division of Telecommunications, Thessaloniki 54 124, Greece

Email: peter.torok@imperial.ac.uk

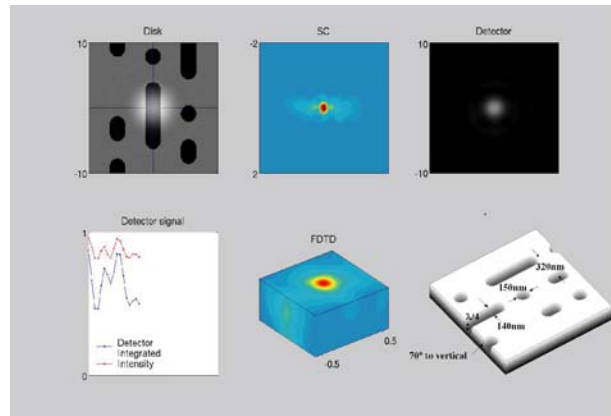
**KEY WORDS:** vectorial model, high numerical aperture, optical data storage

### 1. INTRODUCTION

The possibility of increasing storage density in DVDs and BluRay (BD) systems by means of either optical superresolution or multiplexing has been investigated and this presentation provides an overview of the conclusions. Multiplexing in optical data storage may be regarded as one of the ultimate steps development could take to achieve the terabyte mark in storage capacity. The talk also describes a rigorous model that we have developed to characterise the optical system of DVD/(BD) systems.

### 2. RIGOROUS OPTICAL MODEL

We have developed a rigorous model to simulate the optical system of DVD/BD devices. The model consists of four modules encompassing light propagation from the source to the pit through various optical components, calculation of light scattered by pits (FDTD module), propagation of the scattered light from the FDTD grid to a suitable plane and imaging of light from the plane to the detector. The rigorous model is run on our in-house built computer cluster. It contains 36 nodes, each having a 2.4GHz 32 bit CPU and 1GB on-board memory. We can model a variety of problems using our program, such as optical imaging, scanning microscopes, and optical data storage devices. The example shown in Fig. 1 is a portion of a BD disk (top left) and the illumination incident upon it (output of module 1). The top middle figure shows the modulus of the electric field on the plane as the output of module 3. The top right figure is the intensity distribution at the detector plane (output of module 4). The bottom left figure is the detected intensity as a function of the actual scan position. The bottom middle figure is the output of module 2 and finally the bottom right figure shows the dimensions of the track.



**Fig. 1:** Typical output of our model

### 3. MULTIPLEXING IN OPTICAL DATA STORAGE

The talk discusses practical realisation of multiplexing and points out that it is possible to encode about 330 levels of information in a single pit effectively resulting in an up to 8× increase in storage capacity when compared to either DVD or BD systems. This is done by using an optical set-up that is a polarising light optical microscope. With careful design it is possible to achieve extinction ratios between the co- and cross-polarised paths in the order of  $10^5$ . Experimental evidence based on signal-to-noise considerations shows that in any 45° section 83 different information levels can be distinguished. This in the 0-180° angular range translates to 330 levels or 8.4× increase in data density. Compared to BD system we can therefore achieve 100-200GB/layer storage density.