Abstract - One of the major problems in three-dimensional (3-D) field computation is visualizing the resulting 3-D field distributions. A virtual-reality environment, such as the CAVE, (CAVE Automatic Virtual Environment) is helping to overcome this problem, thus making the results of computation more usable for designers and users of magnets and other electromagnetic devices. As a demonstration of the capabilities of the CAVE, the Elliptical Multipole Wiggler (EMW), an insertion device being designed for the Advanced Photon Source (APS) now being commissioned at Argonne National Laboratory (ANL), was made visible, along with its fields and beam orbits. Other use of the CAVE in preprocessing and postprocessing computation for electromagnetic applications is underway.

I. Introduction

Electromagnetic field analysis and design is more difficult in 3-D than in two dimensions not only because the mathematics is more complex (multiple-valued scalar potentials, gauge conditions on vector potentials) and because the amount of data is greater (more mesh points, three components per mesh point rather than one), but also because visualizing the computational mesh and the results of computations present equally great difficulties.

The CAVE virtual-reality system [1] provides stereoscopic images from any viewpoint of choice, and so can make visualization easier. To this end a demonstration of the CAVE using a rather complex magnet system was undertaken.

For the demonstration one half-period of the APS EMW [2] was chosen. It has a superposition of horizontal fields from electromagnets and vertical fields from hybrid magnets. (In a hybrid magnet, magnet material provides the field, and steel shapes the field.) The CAVE demonstration depicts the magnetic geometry, the field pattern from the combined magnets, and the trajectory of a positron beam traversing the EMW. This paper describes the demonstration and suggests other uses for the CAVE in the process of electromagnetic field computation.

II. The CAVE

The CAVE is a surround-screen projection-based virtual reality system being developed at the Electronic Visualization Laboratory (EVL) at the University of Illinois at Chicago. Computer-generated images are rear-projected onto two walls and the floor of a 3 m x 3 m x 3 m cube. Alternating images are displayed for the left and right eyes in synchronization with stereo shutter glasses, as seen in Fig. 1. The viewer-centered perspective is calculated constantly from tracker data.

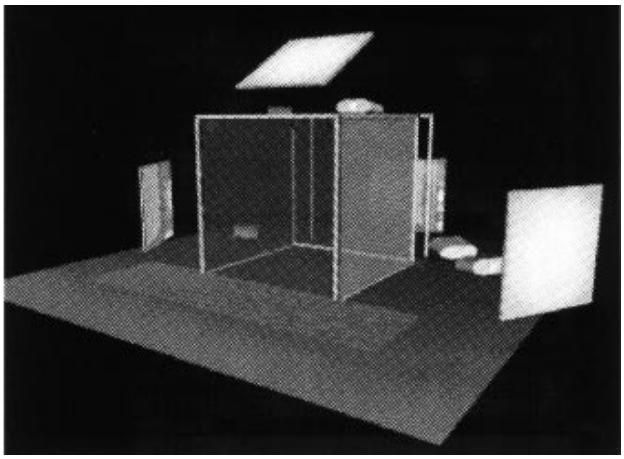

Fig. 1. The CAVE virtual reality environment. Mirrors reflect stereoscopic computer images from the projectors onto two walls and the floor of the cave.

TABLE I Parameters for the APS EMW

Parameter	Value
Minimum Hybrid Magnet Pole Gap	24 mm
Peak Vertical Field with 24-mm gap	0.9 T
Number of Vertical Pole Pairs	33
Horizontal (Electromagnet) Pole Gap	71 mm
Peak Horizontal Field	0.1 T
Number of Horizontal Pole Pairs	36
Maximum Current	1000 A
Number of Turns per Pole	4
Period Length	160 mm
Total Length of Magnet Structure	2.88 m