for example, by more accurately combining information from multiple optical recording devices. The three-dimensional calibration equipment is both an apparatus to use with image capture equipment such as cameras and a method to compensate for the absolute and/or differential distortion within and across stereoscopic imaging equipment used together as a system.

[0151] By employing a holographic projection technique that creates a virtual calibration pattern in the desired object space, the three-dimensional calibration equipment automates the calibration process. As the virtual calibration pattern is viewed by the same lens system in optical recorders that are used for stereoscopic imaging systems, all static distortion will be taken into account. The virtual calibration pattern allows explicit calibration in the desired object's space without the limitations of using real calibration patterns that are moved through the image space.

[0152] One potential use of the higher quality images obtained from the three-dimensional calibration equipment is to more accurately determine the distance to points on the stereoscopically recorded or viewed desired object for uses which include the construction of three dimensional images of desired object. As the three-dimensional calibration equipment is capable of providing calibration during normal stereoscopic operation without affecting the desired image, it is usable for continuous calibration, e.g., when the optical recorders are equipped with variable zoom lenses that exhibit differing optical properties as the zoom setting is changed, or continuous calibration during normal operation when mechanically misalignment of equipment occurs in one or more of the optical paths to the optical recorders. The three-dimensional calibration equipment continuously operates without interfering with the optical recorders.

[0153] By changing the virtual calibration patterns, for example, by varying the hologram frequency when alternative holograms are recorded at different frequencies, several ranges and positions of the image field of view can be continuously recalibrated to compensate for variations in image system distortions (e.g., as the degree of telephoto magnification is changed). With the three-dimensional calibration equipment, a virtual calibration pattern can be produced in any place in the field of view of the optical recorders, and the calibration is done quickly. Compared with other calibration systems, the desired information and the calibration information are recorded through the same lens of each image recorder as the desired image is captured at the same time as the calibration image, which enables real time or post-processing calibration.

[0154] The three-dimensional calibration equipment herein described can operate in real-time and at high speeds, which makes the equipment suitable for applications in which traditional calibration equipment is not suitable, such as in the cockpit of an aircraft, where it is not possible to place a traditional calibration object in field of view. This is especially true when the optical recorders are subject to acceleration or other causes of changes in the optical paths between he desired object and the optical recorders. Having a single frame of reference with known points in the calibration pattern observable in each view simplifies combining multiple camera views to create to produce a three-dimensional representation of a desired object. The three-dimensional calibration equipment of the present invention simplifies conformal mapping from a planar optical recorder to a non-planer coordinate system—holographic project enables each optical recorder to view the same desired coordinate system, e.g., spherical, simplifying point matching and transformation. Computer readable labeling of holographic pattern intersections improved performance as identification of points in the field of view is simplified compared to the searching and matching operations performed in the prior art. The calibration equipment of the present invention can make use of multiple patters, slightly shifted patterns, or patterns with more fine detail to capture different views of the desired object. The calibration equipment **268** which employs laser ranging measurement device **284** is quicker and more precise than traditional triangulation from two optical recorders. The discrete holographic calibration plates of the calibration equipment **318** is lower in cost and less susceptible to vibrations present in moving vehicles compared to using a single calibration plate spanning all optical recorders. When the calibration equipment **354** is used in combination with the stereoscopic microscope **356**, the calibration equipment **354** permits the stereoscopic microscope **356** to capture multiple biometric views from optical recorders with a common virtual calibration pattern.

[0155] It will be understood that the embodiments described herein are merely exemplary and that a person skilled in the art may make many variations and modifications without departing from the spirit and scope of the invention. All such variations and modifications are intended to be included within the scope of the present invention as defined in the appended claims.

What is claimed:

1. A three-dimensional imaging system, comprising:

a three-dimensional display;

an image scanning device for capturing a three-dimensional image to be displayed on said three-dimensional display; and

three-dimensional calibration equipment for calibrating said image scanning device,

wherein both said three-dimensional display and said image scanning device employ optical pulses and non-linear optics to display and record, respectively, a three-dimensional image.

2. The three-dimensional imaging system of claim **1**, wherein said image scanning device is a three-dimensional optical recorder.

3. The three-dimensional imaging system of claim **1**, wherein said image scanning device is a two-dimensional optical recorder.

4. The three-dimensional imaging system of claim **3**, wherein said two-dimensional imaging system includes at least one two-dimensional optical recorder.

5. A three-dimensional display, comprising:

at least three pulsed optical sources; and

an optical mixer movable in a display space,

wherein said at least three pulsed optical sources are spatially separated so as to permit pulses emanating therefrom to overlap in a voxel within said display space and intersecting said optical mixer at a selected position, whereby a first-order non-linear interaction of said pulses causes said optical mixer to produce at least one pre-determined wavelength of electromagnetic waves.

6. The three-dimensional display of claim **5**, wherein said optical mixer includes a plurality of non-linear mixer elements.