

Application of motion capture for the measurement of furniture behavior in shaking table tests

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1. Introduction

A series of full-scale shaking table tests are conducted using the E-Defense shaking table facility on a four-story RC hospital structure. Various furniture items and medical appliances and service equipment are placed in the building. It is find that the displacement of some furniture reached up to 3m during the test. Considering that the current sensors such as linear variable differential transformers (LVDTs) have difficulties in measuring such furniture behavior including large displacement, a motion capture technique is adopted for the measurement of furniture behavior.

2. Basic theories of motion capture

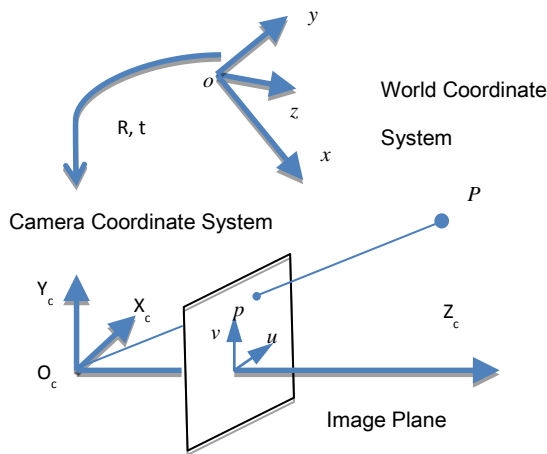


Fig. 1. Pinhole camera model

To reconstruct a scene from images, the relationship between the real world coordinates of a set of point in 3D space with the coordinates of their corresponding image point must be established (see Fig. 1). The relationship can be described by 11 different parameters that are usually categorized into the intrinsic and extrinsic parameters. The parameters of a single camera or a set of cameras are evaluated during

the process, which is usually termed camera calibration. The coordinates of the point in the image plane is obtained by a marker detection technique.

3. Test results

The motion capture technique is first validated by shaking table tests in Kyoto University. Two types of commercial grade cameras are used with a recording speed of 30fps and 60fps frame rate, respectively. Both two types of cameras are equipped with CMOS image sensors and can take a 1920 by 1080 pixels resolution video.

The accuracy of the motion capture technique to measure the displacement and calculate the velocity, the influence of the angle between the two cameras, recording speed, and the error sources are discussed. One of the motion capture results that show a satisfactory accuracy is shown in Fig. 2 in which the data of grid was measured by the grid drawn on the shaking table.

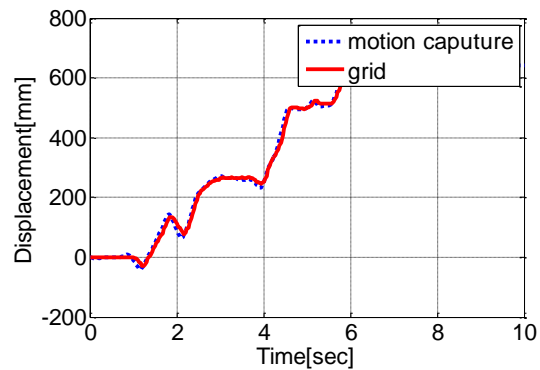


Fig. 2. Displacement of the furniture under JMA kobe The motion capture technique is successfully applied in the E-defense shaking table test to measure the furniture behavior. The problem of camera vibration is discussed and the method to eliminate the influence of vibration is examined.