

## MEASUREMENT OF 3D DISTANCE BETWEEN ARTIFICIAL CUP AND HEAD FROM AP & LATERAL ROENTGENS WITH UNKNOWN ANGLE AFTER THR

SHIGEYOSHI NAKAJIMA<sup>1</sup>, MITSUHIKO IKEBUCHI<sup>2</sup> AND TAKASHI TORIU<sup>1</sup>

<sup>1</sup>Graduate School of Engineering  
Osaka City University  
3-3-138, Sugimoto-cho, Sumiyoshi-ku, Osaka city 558-8585, Japan  
{ nakajima; toriu }@info.eng.osaka-cu.ac.jp

<sup>2</sup>Graduate School of Medicine  
Osaka City University  
1-4-3, Asahi-machi, Abeno-ku, Osaka city 545-8585, Japan  
m1298570@msic.med.osaka-cu.ac.jp

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**ABSTRACT.** *The purpose of our work is precise measurement of 3D distance between a cup as an artificial acetabular and a head as an artificial femoral head in a patient body from AP and lateral Roentgen images without known angle between AP (anterior posterior) and lateral after THR ( Total hip replacement). Recently Martell measured the 2D distance between a cup and a head of an artificial hip joint. And also RSA (roentgen stereophotogrammetric analysis) is famous as a 3D measurement method of things in a living body of a subject. But Martell's method needs a special Roentgen equipment and RSA needs extra surgical invasions. Our method needs only an ordinary Roentgen equipment and doesn't need to know the angle between AP and lateral. Also the invasion of our method is low. But our method is applied only to the cases of cups which rotations are identified with something like notches. We show the result of a computer simulation with CG images we made and also show the result of an experiment in vitro with real roentgen images of artificial cup and head moved by a micro-manipulator.*

**Keywords:** Roentgen, 3D measurement, THR, GA, Medical imaging, Artificial joint, CAD

**1. Introduction.** 3D measurement is one of most important issues in computer science. Satou *et al.* [1] used a mobile robot with a stereo camera to detect human actions in a room. We showed 3D measurement method of an orthodontic treatment result from the 3D scanner data of teeth after the treatment [2]. Also we proposed a method to measure 3D structure of moving object [3]. In orthopedic surgery area, it is very important to know the position and direction of an artificial prosthesis (artificial joint) after a replacement operation. Especially after total hip replacement (THR, or THA, 'A' is for arthroplasty), there is a polyethylene inner between cup and head, and most surgeons are interested in the measurement of the wear and the distortion of the inner from the shadow of an artificial cup and an artificial head. There are no shadows of polyethylene inners in a Roentgen image but there are a cup shadow and a head shadow. But the measurement of them is very difficult. Livermore *et al.* [4]. proposed a method to measure the wear of the artificial hip joint from a 2D image with an artificial cup contour and a head contour. Martell *et al.* [5] made a computer program to achieve Livermore's method. Martell approximated a cup and a head as 2D circles in a Roentgen image, and the distance of the centers of those circles showed the measurement of 2D positions of the prostheses.