

Title: **Measurement of acetabular wear using intelligent ellipses**

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A summary of recent studies¹ reported that of a sample of 100 Total Hip Replacements (THRs) 18 revisions occurred, 16 of which were due to osteolysis and loosening of the acetabular cup. Thus tracking acetabular wear is a key step in the early detection of failure in THRs.

The femoral head and rim of the acetabular cup appear elliptical in radiographs regardless of orientation. This knowledge of shape can be used to measure acetabular wear. Current approaches range from manual methods that estimate the centre of the femoral head using transparent overlays of concentric circles² to semi-automated methods using Sobel edge detection³.

Our aim is to create an automated, accurate and repeatable method that improves on existing performance. It involves the use of *intelligent ellipses* that learn to identify the typical change of the grey level at the femoral head from a set of manually annotated digitized

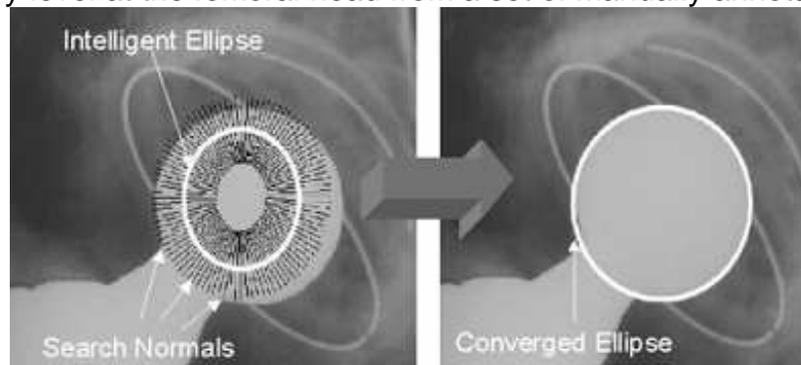


Fig I

Fig II

radiographs. When trained these *intelligent ellipses* are placed within a previously unseen digitised radiograph of a THR. Searching occurs along normals to the *intelligent ellipses* (Fig I) and comparing the normalized grey level derivative profiles (a measurement of the gradient) to a statistical model of the typical grey level derivative around a femoral head. The location and other parameters of the *intelligent ellipses* are altered to best match the model. After several searches the ellipse converges around the femoral head in the radiograph (Fig II). In a similar fashion the rim of the acetabular cup can be located.

Once the centres have been found the distance from the centre of the femoral ellipse to the centre of the acetabular ellipse can be calculated.

References:

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- 2) Livermore, J. and Ilstrup, D. and Morrey, B. Effect of femoral size on wear of the polyethylene acetabular components. Journal of Bone and Joint Surgery. 518-528, 1990.
- 3) J.M. Martell and S. Berdia. Determination of polyethylene wear in total hip replacements using digital radiographs. Journal of Bone and Joint Surgery, 79-A: 1635–1641, 1997.

Podium Presentation

Poster Presentation

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