Update on the Development of an Accurate and Repeatable Method for Assessing the Progression of Osteoarthritis in Knee from Standard Clinical X-rays

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Introduction

Primary radiographic sign for assessing knee OA from AP x-rays is joint space narrowing. Software for fully automated segmentation of femoral and tibial contours was developed as an important step towards providing methods to quantify JSN.

Materials and Methods

The core algorithm estimates statistical models of shape and appearance variation from annotated images and uses these models for segmentation (Seise *et al.*, 2007). The method was evaluated on 30 digitised, standard clinical radiographs of non-osteoarthritic knees using leave-one-out validation. Resolution was such that 1 pixel corresponded to 0.17 mm on the film. Each of the automatically generated segmentations was compared to a manual segmentation in terms of mean point-to-contour distance.

Results

The automatic and manual segmentations were qualitatively similar except for 2 case in which the tibia was erroneously segmented by the automated method. Histograms of the mean point-to-boundary for the remaining cases are given in Figure 1, a typical example is shown in Figure 2.
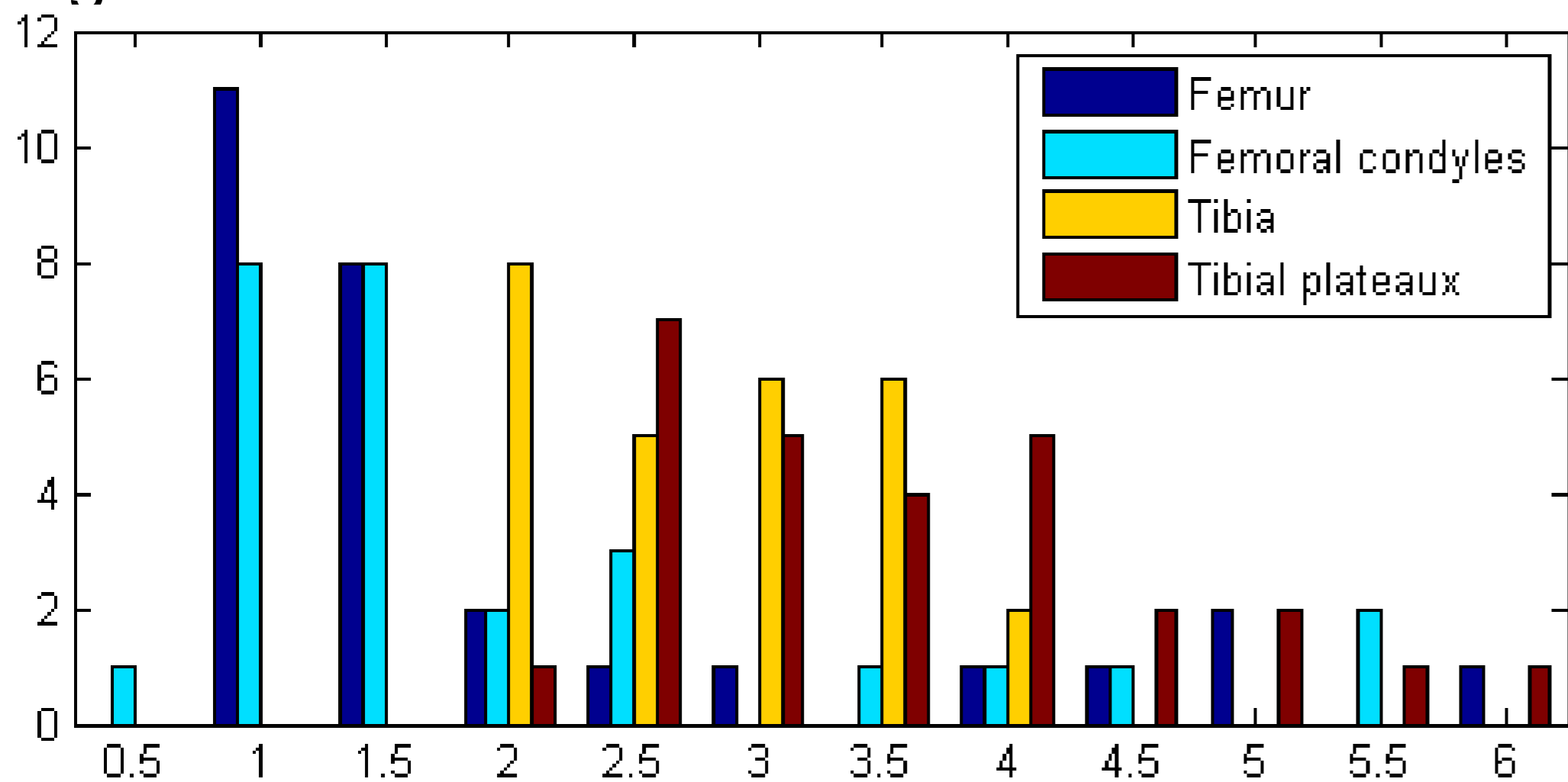

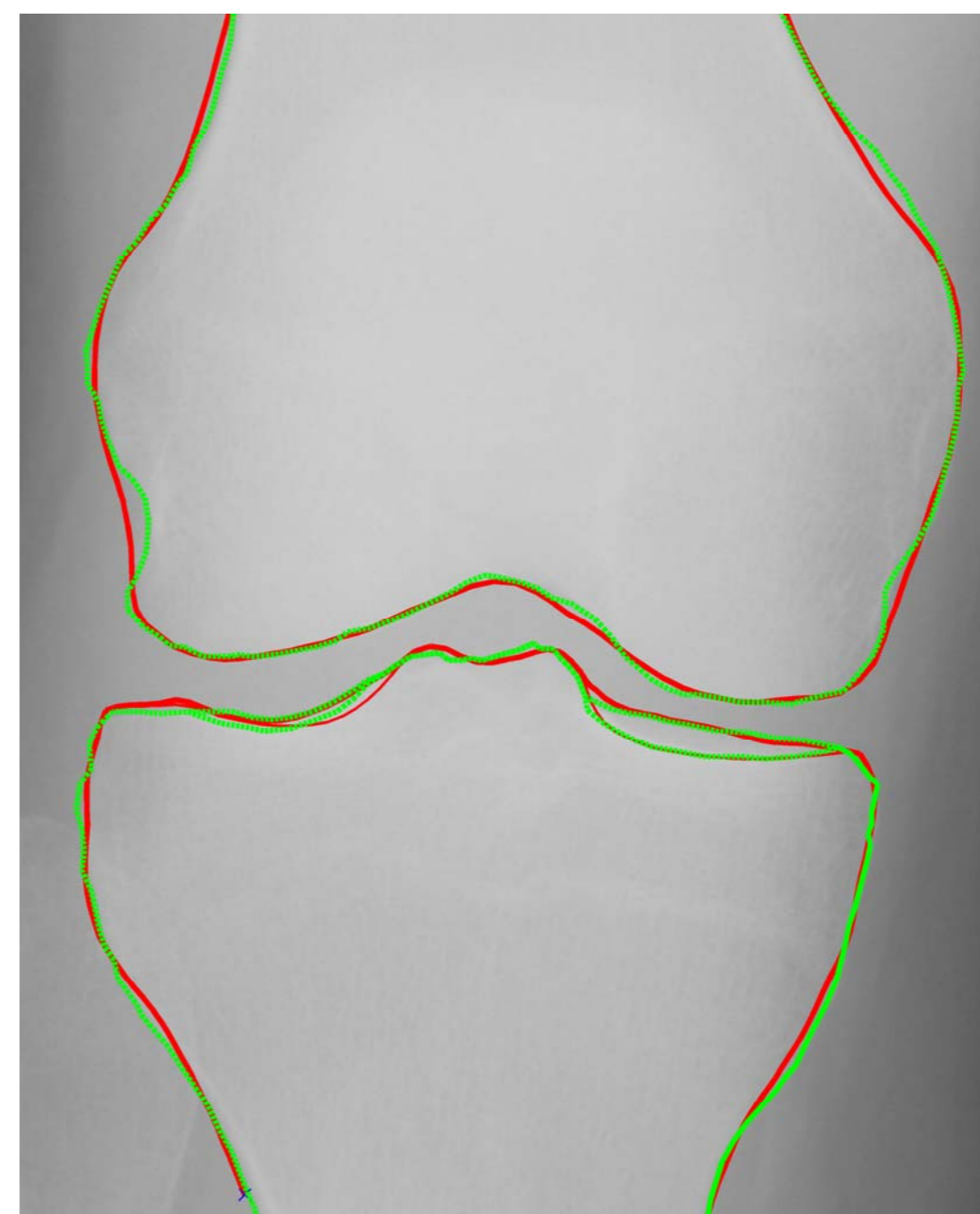Figure 1: Histogram of point-to-contour distances

Figure 2: Example segmentation

Figure 3: Example probabilistic segmentation

Extension: Assessing uncertainty in segmentation

The learned statistical models can be used to assess the uncertainty in the automatic segmentation using statistical inference (Seise *et al.*, 2006). Preliminary results for femur are shown in Figure 3 and 4.
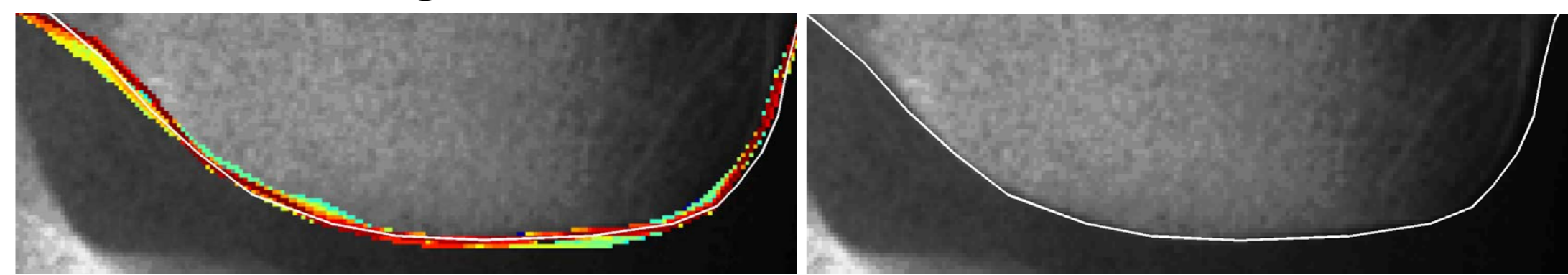

Figure 4: Example probabilistic segmentation

Prospects

Although these initial results are promising, further work is needed to improve accuracy and eliminate the few cases with gross errors. Segmentation of femoral and tibial contours enables measures more strongly correlated with the actual volume of cartilage than the commonly used minimum joint space width to be obtained. Furthermore, the extension allows assessing the uncertainty in these measures.

Seise M, McKenna S J, Ricketts I W, Wigderowitz C A, **"Learning active shape models for bifurcating contours"**, *IEEE Trans Med Imag*, 26(5): 666-677, 2007

Seise M, McKenna S J, Ricketts I W, Wigderowitz C A, **"Probabilistic segmentation of the knee joint from X-ray images"**, *MIUA*, Manchester , 2006

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