# Exploitation of Correspondence Between CC and MLO Views in Computer Aided Mass Detection

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**Abstract.** In this paper we investigate the effect of reclassification of CAD findings using correspondences in MLO and CC views, with the aim of reducing false positives and inconsistencies. We use a method to link regions identified as suspicious in both projections and add a two-view classifier to an existing CAD scheme. The input of this two-view classifier was a feature vector containing the likelihood of malignancy of the region, the likelihood of malignancy of the corresponding region in the other view, and a number of features that describe the resemblance between the both regions. Using FROC analysis we show that detection results improve when using two-view information.

## 1 Introduction

Most methods for computer aided detection of masses in mammograms are limited to analysis of single views. Radiologists, on the other hand, are trained to judge different views in combination. They make comparisons between patterns in the left and right breast, and compare features of suspect abnormalities projected in different views. In mammography it is common to make a medio lateral oblique (MLO) and a cranio caudal (CC) view of each breast. By processing these views independently, CAD systems often mark abnormalities only in one view, even if they appear rather similar visually. This is due to the fact that differences in features computed in the two views may cause a relatively large difference in the levels of suspiciousness assigned to the lesions by the CAD system. By using a fixed display threshold for the CAD markers the lesion may be rendered in one view while in the other it is not. Radiologists tend to complain when this occurs because they find this behavior of the CAD system inconsistent. Moreover, in recent studies it is reported that it is more likely that radiologists ignore CAD marks if they only mark a lesion in one view [1] [2].

In this paper we investigate if correspondence can be utilized to reduce false positives of a mass detection method. We expect that false positives in different projections will be less correlated than true positives. By reclassification of CAD findings using two-view information we aim at decreasing the suspiciousness of false positives while maintaining the strength of the true positives. Moreover, by combining information from two views the difference between the CAD output of true positive projections in two views will be reduced, which will improve consistency of the system.

Susan M. Astley et al. (Eds.): IWDM 2006, LNCS 4046, pp. 237–242, 2006.

Figure 1 presents a schematic overview of the method, which is a cascaded system of three classifiers. The output of the first classifier $L_1(x, y)$ is a measure of suspiciousness at every location in the breast. The mass likelihood $L_2(i)$ is obtained after region segmentation at selected locations $i$ with a high likelihood of malignancy. Finally, $L_3(i)$ is the output of the two-view detection method, in which correspondence between projections is used. Details of the single view stages of the algorithm may be found in [3] [4].

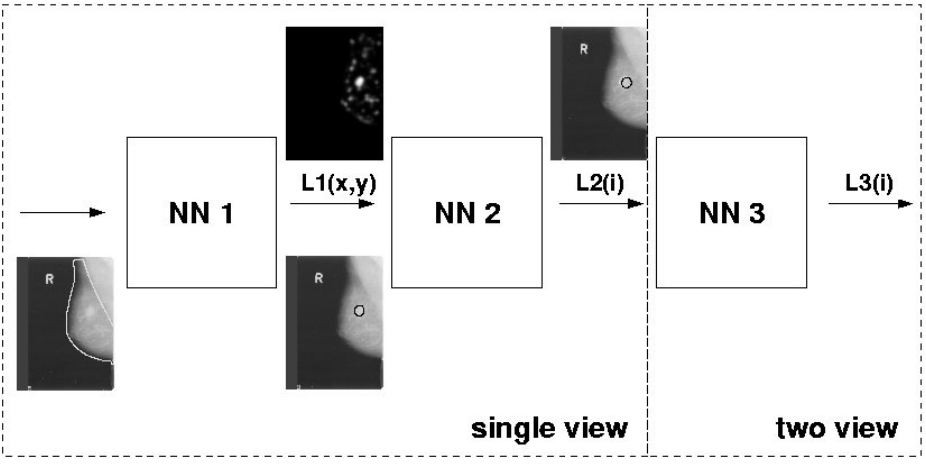


**Fig. 1.** Schematic overview of our CAD scheme

## 2 Finding Corresponding Regions

In our method we determine correspondence between potentially suspicious areas determined by a CAD scheme in MLO and CC views, using the nipple as a landmark. Many radiologists use distance to the nipple to correlate a lesion in MLO and CC views. It is generally believed that this distance remains fairly constant, although other methods are used as well, such as distance to the chest wall/pectoral, or distance of the nipple to a projection of the lesion on a line perpendicular to the chest wall/pectoral (cartesian straight line method). In an attempt to take the effect of compression into account, Kita *et al* [5] used a model-based method to find a curve in the MLO view which corresponds to the potential positions of a point in the CC view. Our choice for distance to the nipple, also referred to as the arc method, was based on experimental evidence and on the fact that it is easy to implement. Chang *et al* [6] provide experimental evidence that the arc method is at least as good as the cartesian straight line method. Further evidence is found in previous studies, where it was found that correlation between distances to the nipple determined in CC and MLO views is high [7], [8].

In the present study we use an automatically determined nipple location to define an annular search area in the other view. The nipple location was roughly