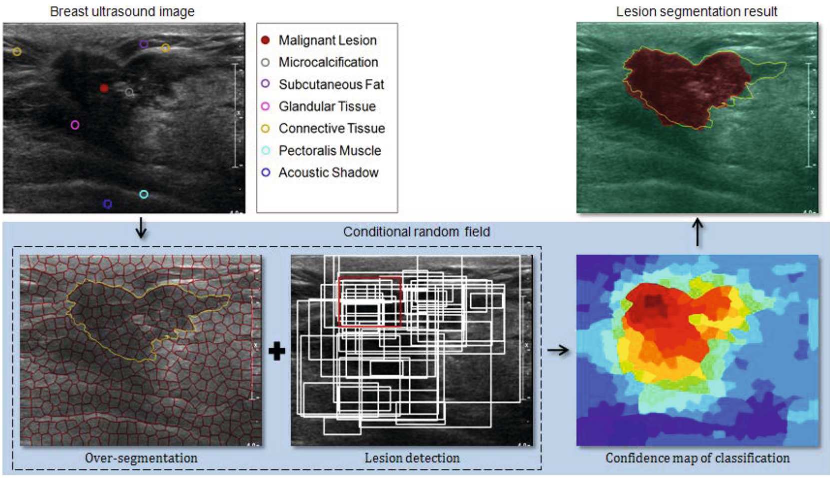

Fig. 1. An overview of the system. The process is depicted anticlockwise. The yellow contours show the groundtruth of lesion. Rectangles in the lower middle image show the detection windows, where the red one has the maximal confidence.

2 Motivations

A sound wave is sent by the sonographic transducer into the human breast, absorbed in or scattered from tissues and structures in it. The reflected wave is captured and processed into a sonogram by the ultrasonic instrument. Intensive research has been done in both fields of radiology and biomedicine [2] to distinguish lesions (both the benign and the cancerous) in ultrasound images from normalities and shadowing artifacts.

The diagnostic criteria can be generalized into the following terms [1]. First, the different echogenicity that nodule and the surrounding area show. A portion of fibrous lesions are hyperechoic with respect to isoechoic fat, while another portion of benign lesions and most of the malignant are markedly hypoechoic. And also, distinguishable internal echotexture can be observed in many cases. Second, the border and the shape of nodule. Benign nodules usually have a thin echogenic pseudocapsule with an ellipsoid shape or several gentle lobulations, and malignant nodules could show radially with spiculations and angular margins. Third, the position of the nodule. Most lesions appear in the middle mammary layer and shadows are produced under the nodules.

These criteria have been translated into computer vision language in many different ways for the design of computer-aided diagnosis system [2]. In [3], Madabhushi and Metaxas build probability distribution models for intensity and echotexture of lesion, based on which they estimate the seed point followed by a region growing procedure. To eliminate the spurious seeds, spatial arrangement together with other rules are then used. At last, the boundaries are located and shaped successively. In [4], Liu *etc.* divide the image into lattices and classify