Chapter 6
Breast Cancer Diagnosis With Mammography: Recent Advances on CBMR-Based CAD Systems

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ABSTRACT

Breast cancer, which is the second-most common and leading cause of cancer death among women, has witnessed growing interest in the two last decades. Fortunately, its early detection is the most effective way to detect and diagnose breast cancer. Although mammography is the gold standard for screening, its difficult interpretation leads to an increase in missed cancers and misinterpreted non-cancerous lesion rates. Therefore, computer-aided diagnosis (CAD) systems can be a great helpful tool for assisting radiologists in mammogram interpretation. Nonetheless, these systems are limited by their black-box outputs, which decreases the radiologists' confidence. To circumvent this limit, content-based mammogram retrieval (CBMR) is used as an alternative to traditional CAD systems. Herein, authors systematically review the state-of-the-art on mammography-based breast cancer CAD methods, while focusing on recent advances in CBMR methods. In order to have a complete review, mammography imaging principles and its correlation with breast anatomy are also discussed.

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INTRODUCTION

The tremendous amount of data became readily available in various application domains, especially in the medical field. This field contains many imaging modalities (such as magnetic resonance imaging (MRI), X-ray computed tomography (CT), digital radiography, mammography and ultrasound), multidimensional images, as well as co-registered multimodality images. These image collections are produced in ever increasing quantities and offer the opportunity for diagnosis, for treatment planning, and for assessing response to treatment (Barhoumi & Baâzaoui, 2014). For breast cancer diagnosis, mammography is the main screening tool for radiologists to visually analyze and evaluate breast density. However, visual diagnosis and mammography interpretation entail several errors in decision-making since it is subjective and thus it is dependent on the physicians' experience. In addition, the breast cancer detection rate improves by about 15% using a second reading. Faced with the increase in the number of mammograms in recent decades, various research studies make the effort either to detect automatically breast lesions through Computer Assisted Detection systems (CADe) or to interpret automatically mammograms through Computer Assisted Diagnostic Systems (CAD). CAD systems can be a great helpful tool to replace the second reader by analyzing a mammogram and making a decision about its abnormality. Besides, they can assist radiologists in their interpretation. However, the major limit of these systems is the black-box outputs, which decrease the radiologists' confidence. To tackle this problem, content-based mammogram retrieval (CBMR) systems, which display similar mammograms, relatively to a query mammogram, with their corresponding similar images, are more and more adopted as an alternative to traditional CAD systems.

All relevant studies, published in Springer Link, Elsevier, IEEE Xplore and pubmed from 2010 to middle of October 2019, were investigated herein to elucidate to the readers the terminologies, various subfields of computer-aided diagnosis based on breast cancer mammography, and the clinical potential. However, unintentionally there is some relevant studies, which can be skipped. Totally, 155 full papers studies were retrieved (abstracts, books, letters, and reports are excluded). All retrieved papers (journal or proceedings) are relevant to the inclusion search criteria, which is "breast cancer diagnosis from mammography". Figure 1 shows a flow diagram, which summarizes the breast cancer diagnosis selection of the retrieved studies. From this figure, it should be noted that the most current CADx systems aim to classify mammogram breast cancer using only a single view, and a few recent studies use breast multi-views (*e.g.* bilateral views (the same view of the two breast), ipsilateral views (two views of the same breast) and four views).