Pattern Recognition Applied to the Computer-Aided Detection and Diagnosis of Breast Cancer from Dynamic Contrast-Enhanced Magnetic Resonance Breast Images

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The goal of this research is to improve the breast cancer screening process based on magnetic resonance imaging (MRI). In a typical MRI breast examination, a radiologist is responsible for visually examining the MR images acquired during the examination and identifying suspect tissues for biopsy. It is known that if multiple radiologists independently analyze the same examinations and we biopsy any lesion that any of our radiologists flagged as suspicious then the overall screening process becomes more sensitive but less specific. Unfortunately cost factors prohibit the use of multiple radiologists for the screening of every breast MR examination. It is thought that instead of having a second expert human radiologist to examine each set of images, that the act of second reading of the examination can be performed by a computer-aided detection and diagnosis system. The research presented in this thesis is focused on the development of a computer-aided detection and diagnosis system for breast cancer screening from dynamic contrast-enhanced magnetic resonance imaging examinations. This thesis presents new computational techniques in supervised learning, unsupervised learning and classifier visualization. The techniques have been applied to breast MR lesion data and have been shown to outperform existing methods yielding a computer aided detection and diagnosis system with a sensitivity of 89% and a specificity of 70%.