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A Hybrid Approach of Using Wavelets and Fuzzy Clustering for Classifying Multispectral Florescence In Situ Hybridization Images

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Abstract

Multicolor or multiplex fluorescence in situ hybridization (M-FISH) imaging is a recently developed molecular cytogenetic diagnosis technique for rapid visualization of genomic aberrations at the chromosomal level. By the simultaneous use of all 24 human chromosome painting probes, M-FISH imaging facilitates precise identification of complex chromosomal rearrangements that are responsible for cancers and genetic diseases. The current approaches, however, cannot have the precision sufficient for clinical use. The reliability of the technique depends primarily on the accurate pixel-wise classification, that is, assigning each pixel into one of the 24 classes of chromosomes based on its six-channel spectral representations. In the paper we introduce a novel approach to improve the accuracy of pixel-wise classification. The approach is based on the combination of fuzzy clustering and wavelet normalization. Two wavelet-based algorithms are used to reduce redundancies and to correct misalignments between multichannel FISH images. In comparison with conventional algorithms, the wavelet-based approaches offer more advantages such as the adaptive feature selection and accurate image registration. The algorithms have been tested on images from normal cells, showing the improvement in classification accuracy. The increased accuracy of pixel-wise classification will improve the reliability of the M-FISH imaging technique in identifying subtle and cryptic chromosomal abnormalities for cancer diagnosis and genetic disorder research.