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Image Informatics Tools for the Analysis of Retinal Images
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Purpose: To develop software tools that can be used for the enhancement and quantitative analysis of retinal images, and to test these methods on a large retinal image database.
Methods: We have assembled a database of over 2000 retinal images that was used for the development of multiple software tools for image analysis. This database is currently being used to study the responses of cell types in the retina before and after retinal detachment. The long-term objective is to provide new information processing techniques allowing the fully automated extraction of information from bio-molecular images.
Results: The tools developed to manage and analyze retinal images on a large scale are currently available at UCSB's Center for Bioimage Informatics website (http://www.bioimage.ucsb.edu). These tools include: 1) a database that can be used for organizing, viewing and searching digital images, 2) software for a digital notebook that allows efficient editing, adding and uploading of metadata and digital images collected by any imaging technique, 3) a software method for local contrast enhancement that corrects unevenness created by illumination and different staining intensities within an image, 4) a software method for image segmentation which can be used to quantize protein distribution within regions of an image, 5) image mosaicing software that assembles large, seamless montages of overlapping images, 6) a detector for cell nuclei which was developed as an ImageJ plugin for accurately detecting and counting cell nuclei that performs with the same accuracy or better as manual counting and 7) an automated method for measuring retinal layer thickness and density to provide quantitative profiles in conjunction with the nuclear detector software.
Conclusions: The retinal image database provides a means for querying raw images and their processed metadata, and combining the images with features for content-based retrieval. The tools developed during this project are useful for quantitatively analyzing large sets of biological images. Ultimately, these techniques will allow for the efficient, accurate and quantitative analysis of biological images as a means of understanding how cells in retina or other tissues respond to stress, injury, aging and disease.
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