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The field of medical image analysis has greatly influenced the practice of neuroscience. Many studies aim to find new disease related anatomical characteristics based on the analysis of Magnetic Resonance images (MRI). Image segmentation is usually a fundamental step, in which brain structures of interest are delineated from MRI. Neuroscientists then categorize segmentations of anatomical structures by attributes such as shape, size, or location. Besides medical images, biometric images such as facial images are gaining more and more attention from clinical research because certain biometric features are also related to neurological diseases. Similar to brain morphology analysis, facial features are collected for studies testing the hypothesis that the disease alters the facial shape.
Despite the rapid development of image analysis technologies, most clinical practice still relies on laborious manual. The aim of this thesis is to develop a shape modeling framework for brain and facial image analysis, for the purpose of clinical practice. Specifically, it focuses on the following three problems: (1) brain structure segmentation from MRI, where several deformable model based segmentation methods are proposed; (2) quantitative analysis of brain morphology, where methods for directly comparing 3D shapes of brain structures are proposed, and clinical applications are demonstrated; (3) facial morphology analysis, where an automatic facial feature localization method is proposed, and applied to the shape analysis of the eyes.