The Use of Geometrical and Physical Models in Medical Image Analysis

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Abstract

The development of methods to accurately and reproducibly recover useful quantitative information from medical images is often hampered by uncertainties in handling these data related to image acquisition parameters, the variability of normal human anatomy and physiology, the presence of disease or other abnormal conditions, and a variety of other factors. In this talk, we will review analysis strategies that make use of models based on geometrical and physical/biomechanical information to help constrain the range of possible solutions in the presence of such uncertainty. We will focus the discussion by looking primarily at three problem areas related to i.) the characterization of cardiac function from noninvasive 4D (3 spatial dimensions plus time) image data, ii.) the analysis of neuroanatomical structure from Magnetic Resonance Images and iii.) the development of an approach that compensates for brain shift when performing image-guided neurosurgery. Within these problem areas, a number of image analysis methodologies that make use of geometrical and physical models will be examined in detail, including: image segmentation, object motion tracking, shape/volume measurement, and deformation analysis. The discussion will include a description of the problem areas and visual examples of the image datasets being used, a brief overview of the mathematical techniques involved and a presentation of results obtained when analyzing actual patient image data using these methods.

Relevant References

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