Quantitative Methods in Medical Imaging

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Abstract

Measurement and comparison of medical images is of growing importance for several reasons: (1) as medical imaging becomes ever more digital, and networks and archives of images proliferate, the opportunity will create the need; (2) automated approaches to treatment design (as in beam therapy), dose measurement (as when using monoclonal antibodies to deliver radiation), and surgery planning (e.g., for orthopedic and neurologic procedures) are emerging from the laboratory and entering limited clinical use; and (3) a greater variety of users (ophthalmology, pathology, and physiology, among others) wants to employ the reliable and repeatable methodology that seems to be offered by the automated methods.

Image-processing tools give us some characterization of shape, size, texture, color, depth, and three-dimensionality. Combined with the properties of the imaging modality and our knowledge of anatomy, they yield quantitative descriptions that are useful in differential diagnosis.

What has received little attention, however, is the need for benchmarking and evaluation of the various methods available. Almost nothing has been done to ensure the comparability of reported results — neither in the data used nor in the measures employed. And the user interface, which may be the clinician's only contact with the application system, has not claimed appreciably more study by system designers than benchmarking. As the need grows to justify the expense of imaging, analysis of its benefits will have to be measured. But until good criteria exist for assessing the imaging system, there cannot be a reliable way to measure outcomes. Equally, use of images from other sites for teaching and research will be impeded in the absence of such metrics.

This paper outlines the problem and suggests some steps that can be taken to bring real quantification to medical imaging.