

Image Quality

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INTRODUCTION

In many applications an image consists of measured data that are processed, either visually or computationally, to yield experimental results. For example, radiologists analyze images looking for signs of abnormality and disease. In addition, scientists routinely extract information from images to help draw their conclusions. Thus, considerable research effort is being spent to produce better imaging systems and image-analysis tools. Of fundamental importance to this research is the definition of *image quality*. Too often a subjective claim is made that the images produced from imaging system A are better than those of system B. The images and the subjective statements about the images become the results of the study, ignoring the fact that modern imaging science is quantitative and objective. Through the use of objective measures of image quality, statements about the merits of imaging systems and image-analysis methods can be backed up by quantitative metrics instead of pictures and subjective claims.

The images we are considering are obtained such that specific tasks can be performed. These tasks range from signal detection to parameter estimation to combinations of the two. Observers, either human or computer, perform these tasks. Thus, there is a tight connection among imaging, tasks, and observer performance. A consensus has been forming around the idea that image quality should be assessed using observer performance as the metric instead of measures that ignore the task.

The ability of an observer to perform a relevant task is limited by the noise sources in the imaging chain and by the normal “background” present in most images. Not only are image quality and observer performance tied to-

gether, but image quality is an inherently statistical concept. The statistics and physics governing the image formation and the statistics characterizing the object being imaged all contribute to the ability, or inability, of an observer to perform tasks and, hence, image quality. In addition, when humans or human models are used as observers, the characteristics of the human visual system must be taken into account.

This special issue of the *Journal of the Optical Society of America A* features 17 papers focusing on image quality. Both application-specific and theoretical papers are included, and the range of topics covers astronomical imaging, medical imaging, human-observer modeling, and video assessment. The editors of this feature have selected papers that display the variety of applications in image-quality research and the intricacies of the field. We acknowledge the efforts of the authors and of the many reviewers who have contributed greatly to this special issue. We further acknowledge the staff of the OSA, who have aided our efforts immensely.

Matthew A. Kupinski
Andrew B. Watson
Jeffrey H. Siewerdsen
Kyle J. Myers
Miguel Eckstein
Feature Editors
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