GUEST EDITORIAL

Special Section on Statistical Issue in Psychometric Assessment of Image Quality

John C. Handley
Xerox Research and Technology
Digital Imaging Technology Center
800 Phillips Road, MS 128-25E
Webster, New York 14580-9701
E-mail: jhandley@crt.xerox.com

John Bunge
Cornell University
Department of Social Statistics
358 Ives Hall
Ithaca, New York 14853-3901
E-mail: jab18@cornell.edu

The human visual system is central to imaging science. The idea of knowing the world through two-dimensional samples was borne from our sense of sight. The human visual system inspires our designs for sensors and algorithms. Yet much of what we consider to be imaging science is in the realm of psychology. Color, for example, is a mental interpretation of sensory data. Quantification of color requires psychophysical techniques to map physical stimuli to cognitive responses.

In the realm of consumer imaging, we determine preference for various imaging techniques, attaching order or scales to broad and complex responses. Through psychometric methods, we try to map out a nebulous psychological space of viewer preferences so that image processing algorithms can be designed to reliably produce pleasing results.

Imaging also augments human decision systems, e.g., a radiologist uses imaging to diagnose abnormal conditions. One models decision processes to understand and automate the way experts come to conclusions and to determine the limits of human expertise.

In all these cases, models and measurements are fraught with complexity and uncertainty. The imaging scientist turns to probabilistic models, experimental design, and statistical analysis to investigate human responses. Our instruments are crude and blunt compared to the complexity of the phenomena we probe. Existence of internal mental states are inferred by correlating different measurements rather than by first principles. Nevertheless, remarkable advances, both theoretical and applied, have been made, the mature field of color science being just one example.

Our science is only as good as our instruments and the focus of this special section is the statistics of psychometrics and psychophysics for imaging. Balakrishnan and McDonald question the foundations of human detection theory in a provocative article. Imai, Tsumura, and Miyake profitably probe the local uncertainty of perceptually uniform color spaces from a different vantage point. Silverstein and Farrell rein in the immense combinatorial explosion inherent in applying paired comparisons to numerous treatments. Finally, Millen and the Guest Editors demonstrate recent and novel data analysis techniques on gamut-mapping preference data.

John C. Handley holds a BS and MS in mathematics from Ohio State University and a PhD in imaging science from Rochester Institute of Technology. He has published over 30 journal and conference papers in document recognition, applied statistics, nonlinear filtering, and random set theory. Dr. Handley was a programmer and research scientist at Online Computer Library Center, Inc. in Dublin, Ohio, for 7 years working on electronic publishing systems and optical character recognition technologies. Since 1995 he has been a member of the research and technical staff at Xerox Corporation in Webster, New York. He holds 5 US patents, with 17 pending. His research interests include document image segmentation, nonlinear filtering, pattern recognition, ranked data analysis, and discrete random sets. He is a member of SPIE, IEEE, and the American Statistical Association.

John Bunge holds a PhD in statistics from Ohio State University. He has worked at OCLC, Inc., and at Kenyon College; since 1990 he has been a member of the statistics faculty at Cornell University, where he is associate professor and director of the Master of Professional Stud-

ies program in applied statistics. He has published research in three main areas, from applied statistics (estimating the number of species in a population), to applied probability (theory of record times and values for stochastic processes), to theoretical probability (random equations and decomposition of probability laws). He is currently working on the species problem, and on confidence sets for various group-valued parameters, including ranks and phylogenetic trees. He collaborates on applied statistical analysis with researchers in a wide range of fields, currently including identification of forest habitats preferred by rare birds, modeling the relationship of workers' pay and firm performance in the technical sector, analyzing the effect of management practices on toxic waste release in manufacturing, and seasonally adjusted demand forecasting for airline reservations. He is a member of the American Statistical Association and the Institute of Mathematical Statistics.