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Computer Vision and Image Analysis of Art

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Introduction

The technical conference *Computer Vision and Image Analysis of Art* was part of the IS&T/SPIE *Electronic Imaging* symposium, held at the San Jose Convention Center in California between January, 17th and 21st, 2010. The papers, demonstrations and posters presented at this larger symposium reflected the state of the art in three-dimensional visualization and multimedia, stereoscopic displays, computational photography, smart phone applications and much more. The future of image analysis applied to the visual arts should be considered in this wider context.

Computer methods have supported art analysis, interpretation, education and dissemination for over a quarter century. A number of collaborative projects carried out in the 1980s involved joint expertise of computer scientists and art historians; for instance the pioneering work enhancing visualization of space in Piero della Francesca's paintings, led by Marilyn Aronberg Lavin; the IBM UK Scientific Centre work on Winchester Solid Modeller (WINSOM) for heritage visualization; and the Morelli content-based retrieval system for images, devised by William Vaughan and implemented in collection databases in the 1980s, subsequently incorporated into the VAN EYCK project (Visual Arts Network for Exchange of Cultural Knowledge). Projects of this kind paved the way for advanced techniques such as those presented in this volume.

Yet a different thread is computer-aided *generation* of art, such as Harold Cohen's early work on the Aaron automated drawing program and A. Michael Noll's computer generation of "faux" Mondrians. All of these shed light on compositional principles in the visual arts.

While documentation and visualization in support of curatorial efforts continues, in the last few years there has been an additional emphasis of computer researchers addressing problems in art: This newer work eschews its traditional supporting role for technical art history, and looks to the computer as an aid to analysis, to help make some of the decisions about an artwork. Thus, algorithms developed for forensic photography analysis now reveal subtleties in lighting within painted *tableaux*. These new algorithms employ subtle statistical analyses of brush strokes or dripped paint for authentication studies. Sophisticated optical ray-tracing analysis software applied to artists' studios reveals whether or not such artists used optical devices. One of the benefits of these approaches is that they can be shared and scrutinized openly by a broad community of scholars.

Such points were stressed in the keynote address delivered by David M. Stone, Professor of Art History at the University of Delaware. He set a theme for the conference by proposing a new, computer-aided approach to connoisseurship. He spoke as if following the footsteps of eighteenth-century authors "on behalf of the science of a connoisseur" (Jonathan Richardson, 1717). This approach prioritizes visual evidence and focuses on formal features of art, rather than meaning, expression, personality or imagination, all of which are difficult to rationalize. Stone spoke of two nineteenth-century champions of connoisseurship, Giovanni Morelli (*Italian Painters,* 1890s) and Bernard Berenson (*The Rudiments of Connoisseurship,* 1894). Morelli's method for identifying the work of individual hands was based on the comparative analysis of ears, eyes and other anatomical features of the depicted sitters. Berenson, who defined connoisseurship broadly as "the comparison of works of art with a view to determining their reciprocal relationship," developed a theory based on Morelli's approach. A number of papers included in this volume are concerned with digital methods for identification, authentication and attribution of an artwork (its technique, materials and composition) to artist, place or period. Some of these methods may be seen as a development stemming from a Morellian belief that characteristics of an individual artistic style can be separated from means of expression and therefore formalized, quantified and verified. The name given to the above-mentioned early pattern recognition system for computerized matching of art images was not accidental.

A reaction against the idea of connoisseurship as an academic pursuit, partly caused by Berenson himself, led to its long-term dormancy. In recent decades mainstream art historians have generally rejected formalist perspectives and have lost interest in the object in favor of iconography, social history, semiotics, psychoanalysis and other more theoretical approaches. Attribution and authentication have nonetheless remained a critical part of any scientific examination of art, especially in a museum context, and are paramount in art documentation, restoration and valuation. Technical art history, or heritage science, has emerged as a modern discipline that bridges traditional practical skills and scholarship with the latest developments in digital technologies. Electronic imaging, in particular, is proving invaluable in art analysis. This collection of papers presents case studies in application of laser- and structured-light scanning, x-rays, multimodal microscopy, spectral analysis and other techniques that allow for a better understanding of artifacts.

If computer science is to continue to support art analysis, we must ensure that the insights gained benefit both disciplines. This can only happen if and when research questions are formulated through dialogue and collaboration. Parallels

have been drawn, by David Ebitz in 1988 and others, between scientific enquiry and connoisseurship. We now need to connect a modern connoisseurship—one that makes full use of computer methods—to art history, and connect art history to the object. A virtual artifact may become a vehicle for mediating this process within the ever more popular collaborative virtual research environment (VRE), though computer methods and digital media can never, and will never, replace close reading of actual art works.

While the authors are grateful for the opportunity to present their research and have the papers published, we hope these proceedings will stimulate discussion and new collaborations between scholars in computer science and the arts.

We editors would like to thank all the contributors, reviewers, attendees, and the staff of IS&T/SPIE for making the conference a success, and we are especially glad that IS&T/SPIE recognize the value of the interdisciplinary research that appears in this volume.

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