

COMPUTATIONAL ART HISTORY

2014 RESEARCH ACTIVITY REPORT

C. Richard Johnson, Jr. :: Cornell University :: January 2015

Matching Manufactured Patterns in Art Supports

Fundamentally, when an art historian derives needed information solely from examination of an image of the art object, signal/image processing should be able to assist and expand the scholarly reach of the art historian. With this basic expectation, in 2005, Professor Johnson began shifting his scholarship to a search for applications of signal processing that advanced understanding of issues in art history. Ultimately, his efforts focused on the identification and matching of patterns visible in particular images of the supports of art works. This forensic data can prove invaluable in assessments of dating and authenticity, as well as in characterization of the artist's studio practice.

- **TCAP** (<http://people.ece.cornell.edu/johnson/tcap.html>) :: In 2007, Professor founded the Thread Count Automation Project (TCAP) to develop and exploit signal processing algorithms to estimate the thread count of the canvas of Old Master paintings from scanned x-radiographs. This effort developed a new method for identifying canvas rollmates based on matching striped patterns in the thread counts of canvas from the same roll.
- **HPPC** (<http://people.ece.cornell.edu/johnson/hppc.html>) :: In 2010, Professor Johnson initiated the Historic Photographic Paper Classification (HPPC) challenge in cooperation with the Museum of Modern Art. This work has established that a variety of texture classification schemes can use raking light photomicrographs to identify papers with the same meta-data, i.e. manufacturer, surface finish, brand, and date of manufacture.
- **CLiP** (<http://people.ece.cornell.edu/johnson/CLiP.html>) :: Professor Johnson launched the Chain Line Pattern (CLiP) Matching Project with the Morgan Library & Museum in 2012, with the Rijksmuseum and the Metropolitan Museum of Art joining this effort in 2013, and the Dutch University Institute for Art History joining in 2014. This research attempts to identify pre-1750 laid papers made on the same mold.

The various signal processing procedures developed in these projects for identifying and matching manufactured patterns in fine art support materials are having an impact on dating and attribution, in addition to the physical characterization of works of art. Of these 3 projects, TCAP and HPPC have reached the stage where the problems have been successfully mathematicized, basic working solutions have been proposed, scientific-quality image data has been made publicly available, a new generation of improved algorithms is under development, the range of artworks to which these techniques are being applied is broadening, and the number of participating researchers is increasing.

Their management has been passed on: TCAP to Rob Erdmann now at the Rijksmuseum and HPPC to Andy Klein now at Western Washington University.

The CLiP project is the one that received the most attention from Professor Johnson in 2014, with a number of semi-automated studies aimed at characterizing the distribution of chain line spacings and relative angles in an attempt to determine the number of adjacent chain lines needed to capture (almost) all of the true matches and reduce false matches to a tolerable level. Preliminary results can be found in item 3 in the list of publications provided below. These studies were greatly enhanced during Professor Johnson's stay in Florence in May 2014, when he persuaded the Dutch University Institute for Art History to join the CLiP project by sharing their exceptional collection of hundreds of full-print images of Rembrandt's etchings revealing chain line patterns in the laid paper supports. Studying and processing these images will be a major research activity in 2015 for Professor Johnson.

New Responsibilities

In 2014, Professor Johnson served as a guest editor in the assembly of a special issue of the *IEEE Signal Processing Magazine* on signal processing for art investigation to appear in July 2015.

In July 2014 at the 2nd Gordon Research Conference on Scientific Methods in Cultural Heritage Research: Challenges and Complexity in Characterization and Conservation, Professor Johnson was elected co-Vice-chair of the 2016 (3rd) edition of this conference and co-Chair of the 2018 (4th) edition.

During 2014, Professor Johnson began planning with the Rijksmuseum for a series of three biannual workshops (in June 2015, 2017, and 2019) intended to define attractive projects for the next decade in computational art history.

Late in 2014, Professor Johnson was invited to submit a book to the new Springer series on Cultural Heritage Science. Development of this manuscript will be a major task for Professor Johnson in 2015 and subsequent years.

Publications

Reprints available upon request to johnson@ece.cornell.edu.

1. C. R. Johnson, Jr., P. Messier, W. A. Sethares, A. G. Klein, C. Brown, A. H. Do, P. Klausmeyer, P. Abry, S. Jaffard, H. Wendt, S. Roux, N. Pustelnik, N. van Noord, L. van der Matten, E. Postma, J. Coddington, L. A. Daffner, H. Murata, H. Wilhelm, S. Wood, and M. Messier, "Pursuing Automated Classification of Historic Photographic Papers from Raking Light Images," *Journal of the American Institute for Conservation*, Vol. 53, No. 3, pp. 159-170, 2014.
2. P. Messier and C. R. Johnson, Jr., "Automated Surface Texture Classification of Photographic Print Media," invited paper, *Proc. Asilomar Conf. on Signals, Systems, and Computers*, Pacific Grove, CA, November 2014.

3. C. R. Johnson, Jr., W. A. Sethares, M. H. Ellis, and S. Haqqi, “Hunting for Paper Moldmates Among Rembrandt’s Prints,” *IEEE Signal Processing Magazine* (special issue on signal processing for art investigation), to appear July 2015.

Reprints of other publications by Professor Johnson and further information about his research are available from <http://people.ece.cornell.edu/johnson/>.

Talks

- “Signal Processing in Computational Art History”
 - Guest lecture, ECE 2200, Cornell University, Ithaca, NY, April 22, 2014
 - Invited lecture, Art Conservation Department, SUNY Buffalo State, Buffalo, NY, April 23, 2014
 - Opening plenary, IEEE International Conference on Acoustics, Speech, and Signal Processing, Florence, Italy, May 6, 2014
 - Short course, Dip. Ingegneria Informazione, University of Pisa, Italy, May 26-28, 2014
 - Invited lecture, Ecoles Normales Supérieures - Lyon, France, June 3, 2014
 - Invited lecture, ETIS, ENSEA, Cergy, France, June 17, 2014
 - Invited lecture, Ecole Supérieure d’Electricité, Gif-sur-Yvette, France, June 24, 2014
- “Research in Computational Art History: Identifying Patterns in Supports”
 - Invited lecture, Center for Research and Restoration of Museums of France, Paris, France, June 10, 2014
 - Invited lecture, Fondation Custodia, Paris, France, June 30, 2014
- “On the Feasibility of Classifying Historic (Photographic) Papers via Texture Similarity Analysis From Raking Light Images”
 - Invited paper, 2nd Gordon Research Conference on Scientific Methods in Cultural Heritage Research: Challenges and Complexity in Characterization and Conservation, Newry, ME, July 31, 2014
- “Thread Counting and Rollmate Identification”
 - Short course, Courtauld Institute of Art, London, England, October 10, 2014