DAVIDSON

Examining paintings on wood or canvas using 3D x-ray imaging with Digitome®

Dan Boye*, Rebecca Garner, Ryan Kozlowski
Davidson College, Davidson, NC 28035, USA
daboye@davidson.edu

Digitome Corporation
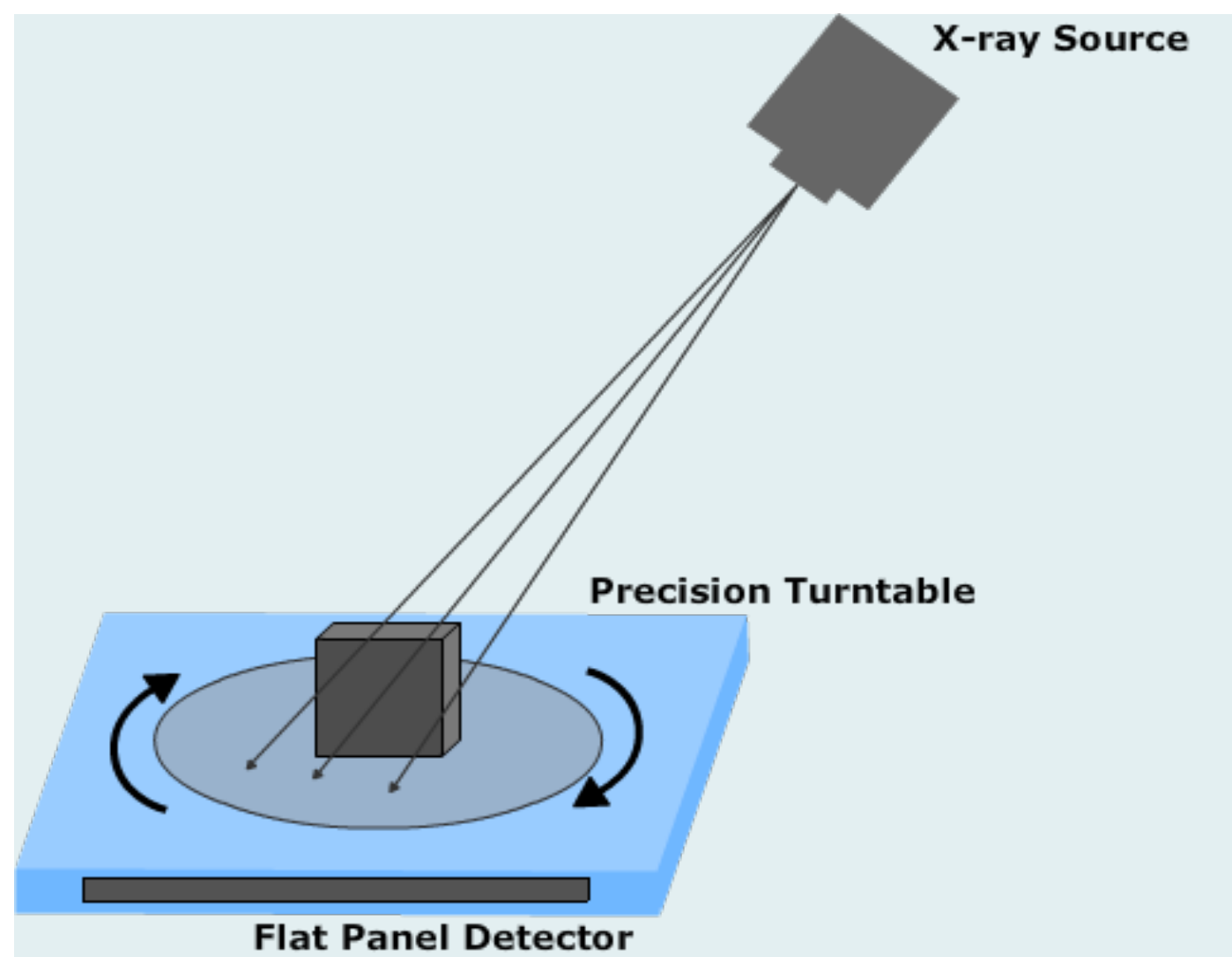Volumetric X-ray Imaging

Abstract

X-ray imaging in three dimensions offers many exciting possibilities for application to art and artifacts. We demonstrate the application of a newly-available 3D x-ray imaging technology, Digitome®, to the examination of paintings on wood or canvas with supporting understructures in the form of cradles or stretcher/strainer bars. Traditional transmission x-ray images of such paintings show a superposition of the paint layer, the wood panel or canvas plus the horizontal and vertical cross pieces from the underlying support. Selecting the focal plane of the Digitome view to be at the level of the paint layer virtually eliminates contributions from the support structure and the full gray-scale range is applied to the paint layer. Accurate and precise measurements can be made of panel thickness and the width, depth and extent of cracks. For paintings on canvas, the thread size and count can be determined.

Digitome Technology

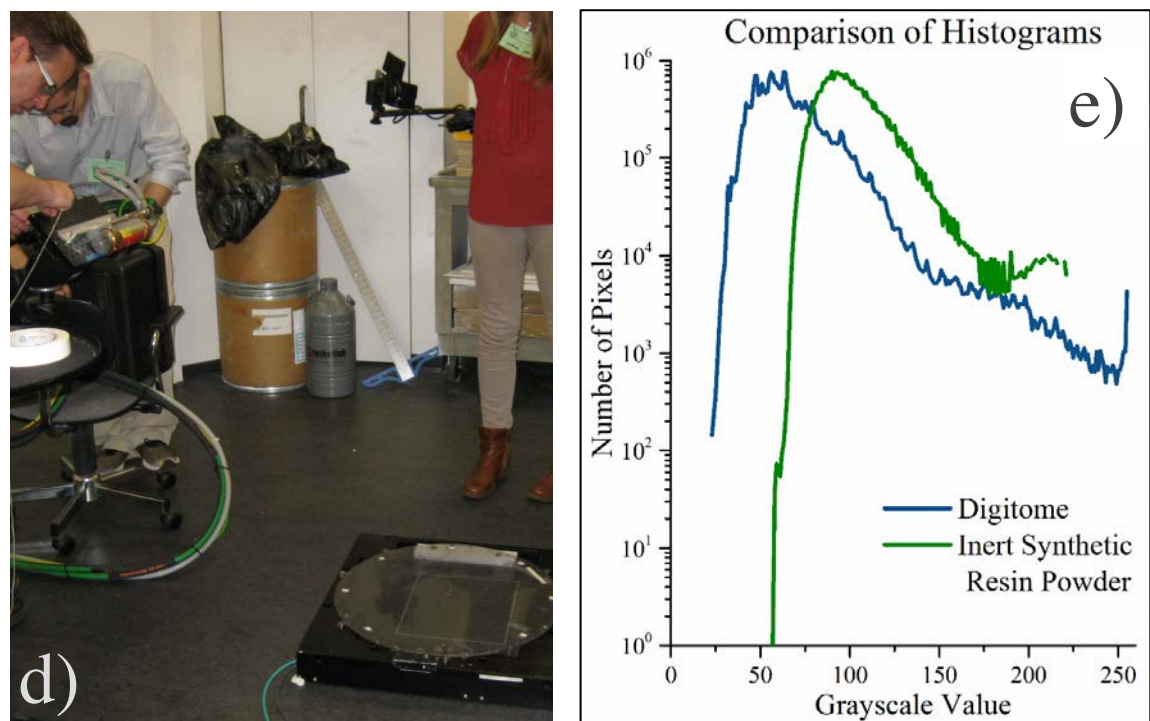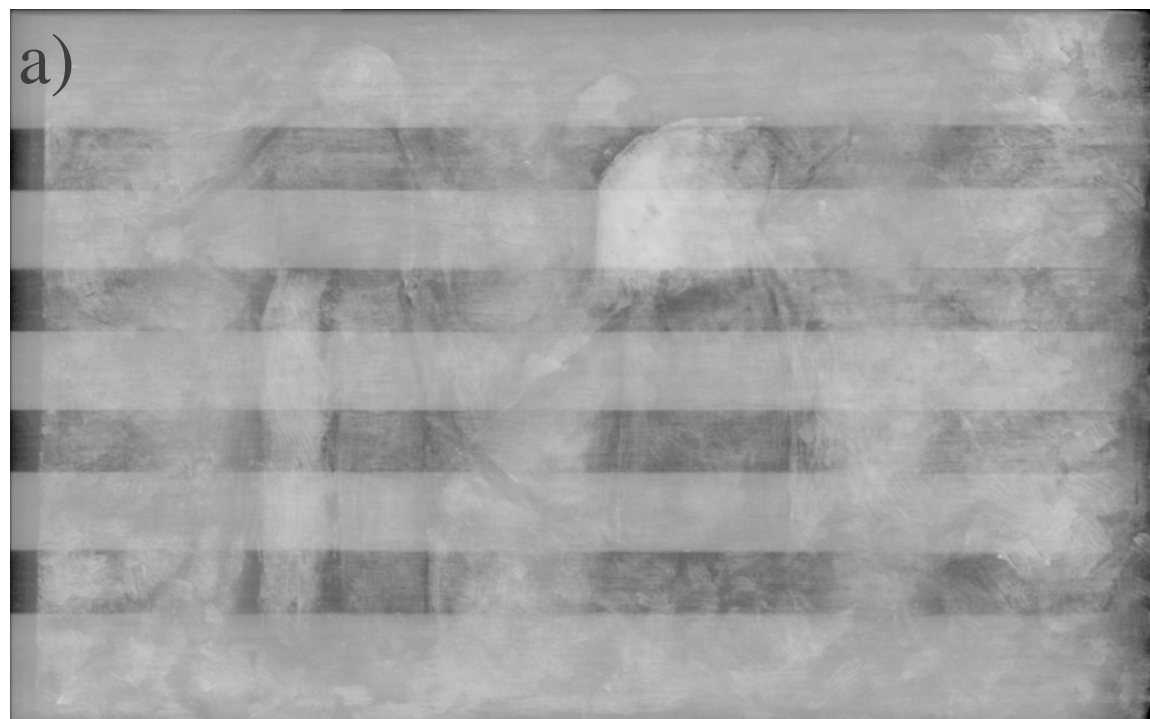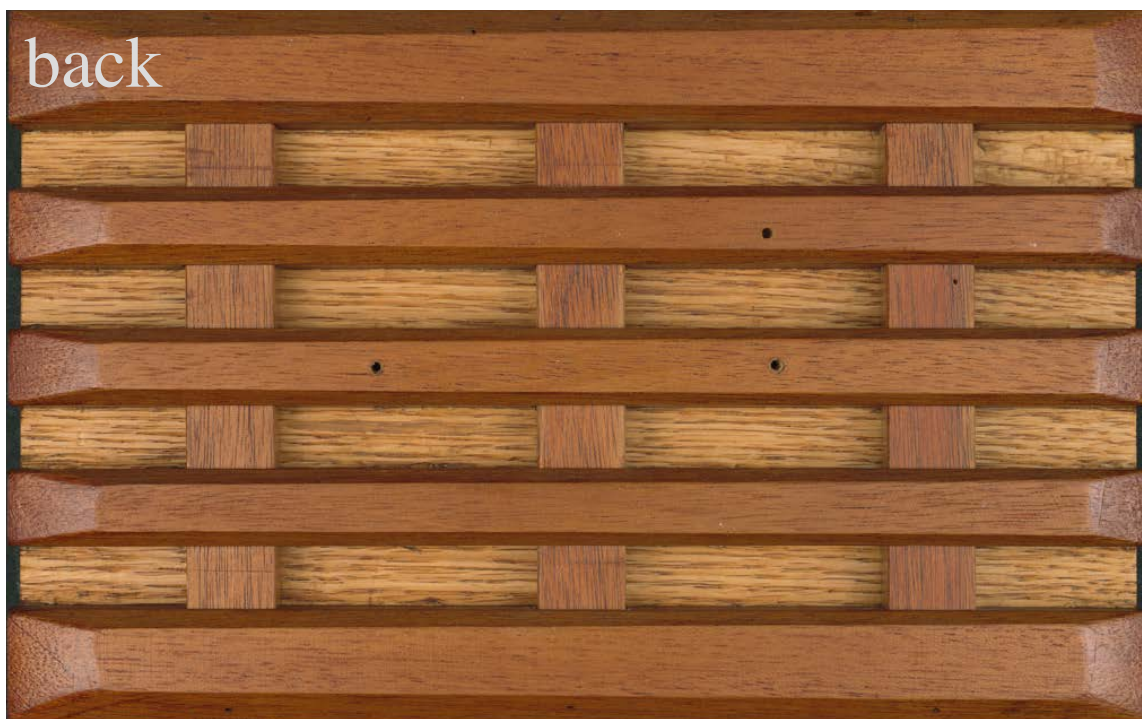X-ray Source
Precision Turntable
Flat Panel Detector

Digitome technology uses several (usually 8-16 images per exam) 2D radiographs acquired from multiple perspectives. Full volumetric information is available since the entirety of object is contained in each radiograph. The user selects two angular rotations and two translational axes in choosing the focal plane. Scans of these parameters can be exported as stacks of images.

Advantages

- Portable – only requires DR panel, x-ray source and Digitome software
- Accurate, precise and repeatable dimensioning along any axis
- Acquisition is non-tomographic – no interpolation between slices
- Non-destructive method of studying art and archaeological artifacts
- Quick exam acquisition time (~15 minutes for small paintings; larger paintings can be stitched). Small dataset provides for near real-time changes in view
- Flexible configurations

Haymakers at Montfermeil - Georges Seurat, c. 1882
(6.125 × 9.75 in.)

back

a)
b)
c)
d)
e) Comparison of Histograms

Digitome output - no post-processing

This oil on wood painting was bequest to the *National Gallery of Art* by Mr. and Mrs. Paul Mellon. Images shown here are scaled to 4/5 of actual size.

a) Traditional 2D radiograph.
b) Cradle is masked by adding inert synthetic resin powder to the gaps in the cradle to match absorption of wood.
c) Digitome exam result.
d) Exam configuration for Seurat painting in NGA's x-ray vault.
e) Gray-scale histograms show greater spread of image information from Digitome over powder image. (8-bit range)
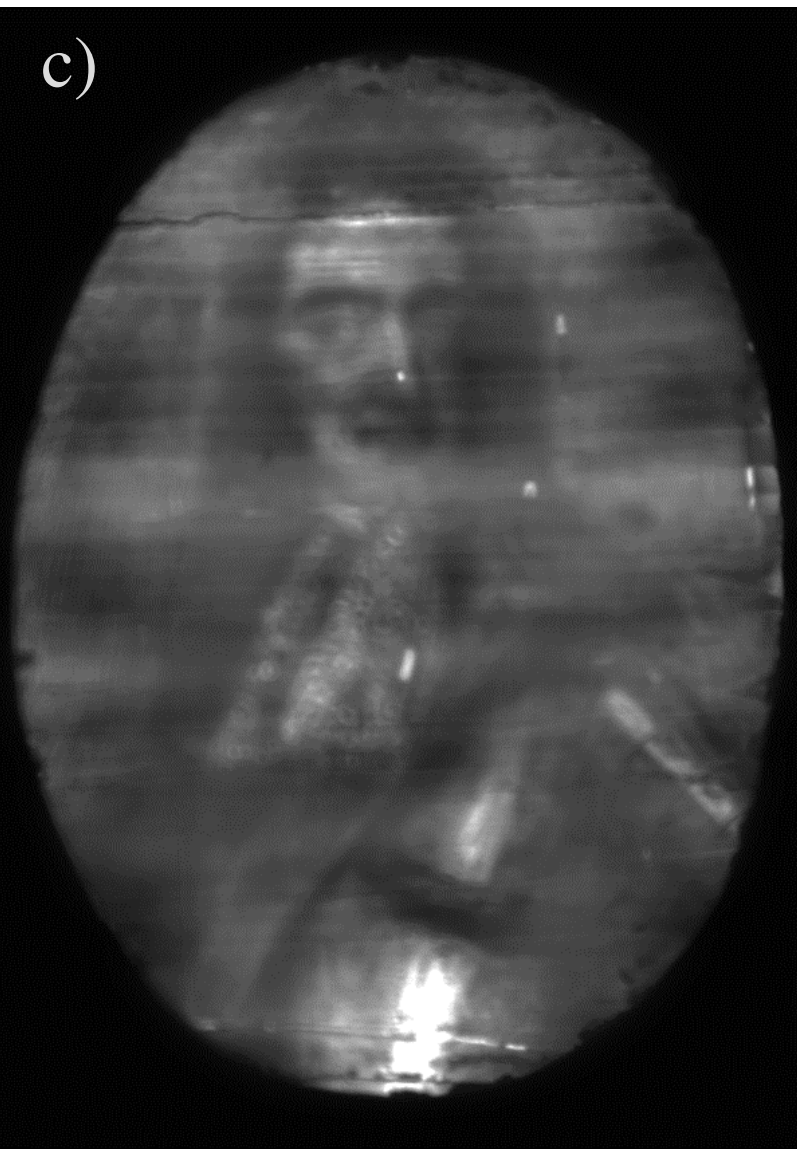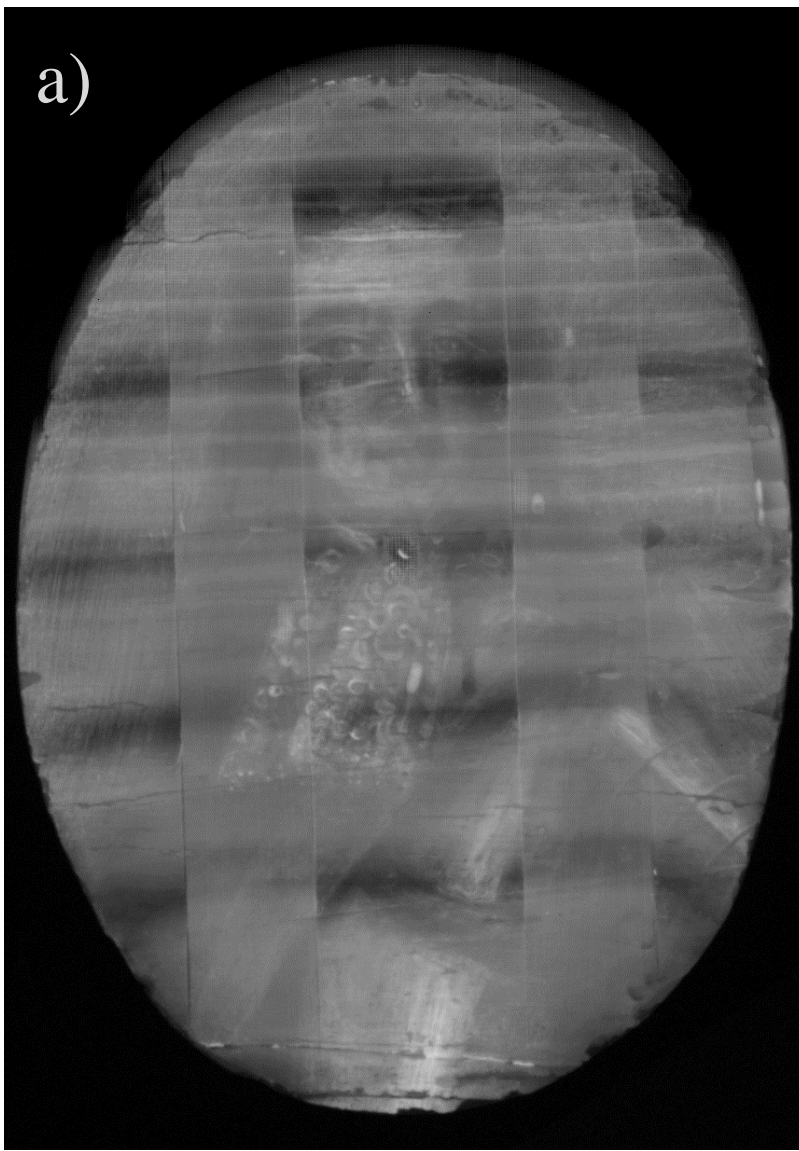
Exam conditions for Seurat painting: 75 kVp, 2.0 mA

King William III – Anon.
(4.25 × 5.7 in.)

The Colonial Williamsburg Foundation has a matching set of portraits of King William III and Queen Mary. The portrait of King William seen below is oil on a panel with *horizontal* wood grain, unusual for this type of portrait. With Digitome, we are able to measure the crack depths along the grain of the wood. The voids in the paint surface caused by the cracks were filled by earlier conservation work.

back
85-33-1
a)
b)
c)

a) Wooden cradle obstructs view of painting in traditional 2D radiograph.
b) Digitome level in the plane of the painting. Multiple cracks apparent.
c) Digitome level in plane of panel backside. Note several highly absorptive spots in focus that are wood damage patches.

Thickness at center of panel measured in Digitome: ~ 0.036 in.

Exam conditions for King William III portrait: 50 kVp, 3.0 mA

Digitome output - no post-processing

back
N° 3001
RELINED 1947
F. GOYA Y L.
1746-1828

a)
b)

Digitome stitch - no post-processing

The Hatseller
(10 × 12 in.)

Exam conditions for The Hatseller: 70 kVp, 0.5 mA

This Goya-esque painting is part of the *Davidson College Art Collection*. Mounting nails and crossed wooden stretcher, about 0.5 in thick, are clear in the traditional 2D radiograph. With Digitome set to present the plane of the paint on the canvas, the wood and nails are nearly undetectable. Canvas thread count is 9 threads/cm.

a) Traditional 2D radiograph.
b) Digitome composite at level of paint.

Conclusions

Digitome non-destructively removes from view underlying support structures so that full gray-scale range can be devoted to paint layer. Portability and flexibility of configuration allows art to be examined without leaving the museum. Accurate, precise and reproducible measurement provided by this scientific tool.

- Challenge: Limited by the active area of detector in the size of paintings we can examine in a single, all-encompassing exam Manual stitching from adjacent exams is possible as in the composite image shown of *The Hatseller*.

- Future Work: Explore more applications of Digitome in conservation of paintings, art objects and artifacts.

Acknowledgements