Physicists uncover secrets hidden beneath the surface of great works of art

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Gallery owners, private collectors, conservators, museums and art dealers face many problems in protecting and evaluating their collections such as determining origin, authenticity and discovery of forgery, as well as conservation issues. Today these problems are more accurately addressed through the application of modern, non-destructive, "hi-tech" techniques.

Dmitry Gavrilov, a PhD student in the Department of Physics at the University of Windsor (Windsor, Canada), along with Dr. Roman Gr. Maev, the Department of Physics Professor at the University of Windsor (Windsor, Canada) and Professor Dr. Darryl Almond of the University of Bath (Bath, UK) have been busy applying modern techniques to this age-old field. Infrared imaging, thermography, spectroscopy, UV fluorescence analysis, and acoustic microscopy are among the innovative approaches they are using to conduct pre-restoration analysis of works of art. Some fascinating results from their applications are published today in the *Canadian Journal of Physics*.

Since the early 1900s, using infrared imaging in various wave bands, scientists have been able to see what parts of artworks have been retouched or altered and sometimes even reveal the artist's original sketches beneath layers of the paint. Thermography is a relatively new approach in art analysis that allows for deep subsurface investigation to find defects and past reparations. To a conservator these new methods are key in saving priceless works from further damage.

Gavrilov explains, "We applied new approaches in processing thermographic data, materials spectra data, and also the technique referred to as craquelure pattern analysis. The latter is based on advanced morphological processing of images of surface cracks. These cracks, caused by a number of factors such as structure of canvas, paints and binders used, can uncover important clues on the origins of a painting."

"Air-coupled acoustic imaging and acoustic microscopy are other innovative approaches which have been developed and introduced into art analysis by our team under supervision of Dr. Roman Gr. Maev. The technique has proven to be extremely sensitive to small layer detachments and allows for the detection of early stages of degradation. It is based on the same principles as medical and industrial ultrasound, namely, the sending a sound wave to the sample and receiving it back. "

Spectroscopy is a technique that has been useful in the fight against art fraud. It can determine chemical composition of pigments and binders, which is essential information in the hands of an art specialist in revealing fakes. As described in the paper, "…according to the FBI, the value of art fraud, forgery and theft is up to $6 billion per year, which makes it the third most lucrative crime in the world after drug trafficking and the illegal weapons trade."

One might wonder how these modern applications can be safe for delicate works of art when even flash photography is banned in art galleries. The authors discuss this and other safety concerns, describing both historic and modern-day implications of flash bulbs and exhibit illumination and scientific methods. As the paper concludes, the authors suggest that we can expect that the number of "hi-tech" techniques will only increase. In the future, art experts will likely have a variety of tools to help them solve many of the mysteries hiding beneath the layers.

More information: The article titled "A review of imaging methods in analysis of works of art. Thermographic imaging method in art analysis." by D. Gavrilov, R. Gr. Maev, and D. P. Almond is published today in the *Canadian Journal of Physics.* DOI: dx.doi.org/10.1139/cjp-2013-0128

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