9/2/2015

# FILMIC – A New Approach to Film Preservation

*Using Multi-Spectral Imaging Techniques*

 – Jim Lindner, Josef Marc.

# FILMIC – A New Approach to Film Preservation

*Using Multi-Spectral Imaging Techniques*

Color scientists, printer manufacturers, mathematicians, statisticians and color computing experts in many disciplines are now demonstrating the far-reaching benefits of multi-spectral scanning for applications in medicine, ecology, manufacturing and industrial processes. Media Matters proposes to apply multi-spectral imaging techniques to the preservation and digital uses of motion picture film. In addition Media Matters proposes a new data base structure for the preservation of film. This data base will contain other physical metadata about the original film including dimensional information and condition information. The goal is to produce a FILMIC database that is a virtual representation of the film itself, as opposed to 2 dimensional scan of film frames at a given resolution with limited spectral information. Because film deteriorates even with cold storage, a better preservation technique that is truly representative of the original film carrier is necessary. The FILMIC approach allows a much more complete and complex data representation of the film, allowing for far more accurate and representative preservation then ever before conceived.

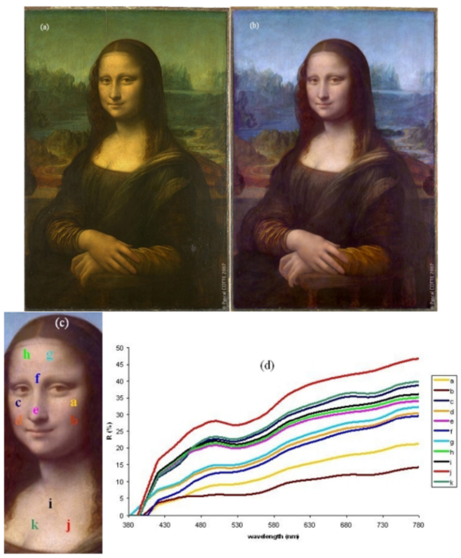
## What Is Multi-Spectral Imaging?

Multi-Spectral or Hyper-spectral imaging is a combination of conventional RGB imaging and spectroscopy. In Multi-spectral imaging a complete spectrum is collected at every location of the film plane as opposed to just an RGB value. In addition, Multi-Spectral Spectral imaging is not restricted to visible light, but works from ultraviolet to infrared. This additional spectral information tells us things like where dust is on the surface of the film or when scratches go through the emulsion of the film.

Multi-Spectral and Hyper-spectral allows for an entirely new set of algorithmic tools as well as preservation and restoration approaches that are not possible with conventional RGB scanning. These techniques allow for very powerful color correction that can even recover lost, faded, or dye damaged film which is not possible with conventional approaches because there is not enough data in current preservation scanning to reconstruct the actual spectral component of the film.

## What are some of the things that this approach can allow?

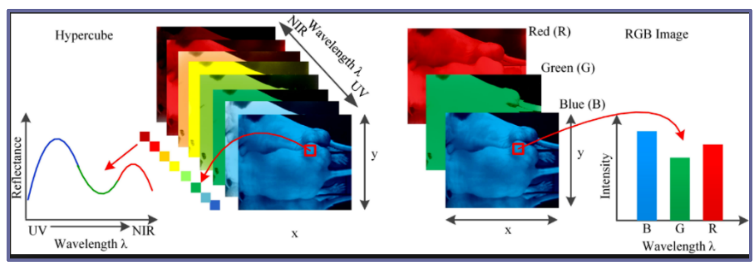
While Multi-Spectral and Hyper-Spectral imaging is a new concept for motion picture film preservation, they are established technologies for image research and preservation. In the fine arts area, for example, Multi-spectral imaging has been used to determine fraudulent art work or uncovering art that has been over painted. Recently Multi-Spectral techniques have been used for the visualization of the deterioration of varnish applied to fine art, and used to reveal the true colors used by the artist when painting the work.



What did the Mona Lisa look like when Da Vinci painted it?

How did they do this?

- Determined the spectral signature of aged varnish, even parts outside the visible spectrum
- Collected multi-spectral data about the Mona Lisa
- Analyzed at various points
- Subtracted “aged varnish” spectral data

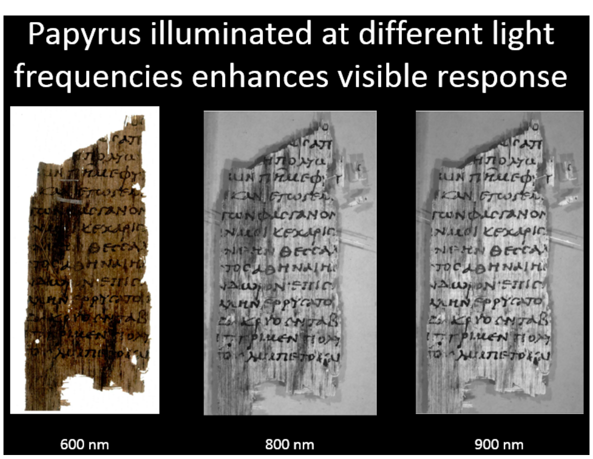



## What’s Wrong with Traditional Digital Film Scanning?

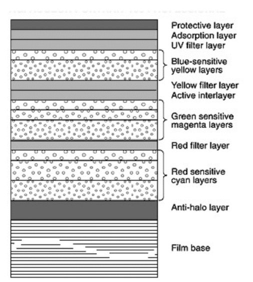
Traditional RGB scanning is the end result of shining a light through the film. It preserves one version of an end product, and little or no information about the object that created that end product.

Film is both reflectant and transmissive, meaning, its native colors are detected by capturing the light reflected from it, and different colors are detected by shining light through it.

RGB is only three colors, widely spaced in a two-dimensional raster. The colors are captured in a color space suitable to electronic cameras and electronic displays which have always been limited color spaces. Modern cameras and displays have capabilities far beyond traditional color spaces, and they continue to improve in areas of color gamut, dynamic range, resolution and more.




Film has never been constrained by electronics limitations because it’s a mix of chemical dyes encased in a three-dimensional object.



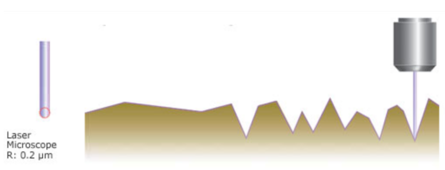
Traditional scanning tells us little or nothing about the physical topology of the film.

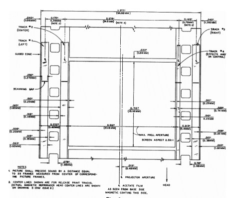
Were the scanned lines in focus at all times?

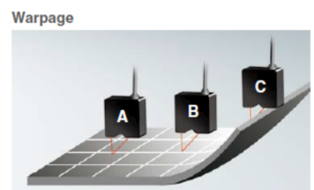
What was the condition of the substrate's current clarity at the angle which the light passed through it?

## Conventional Digital Film Preservation Ignores Carrier Condition

The condition of the film itself is largely ignored in current film preservation technology, yet this information is vital to the understanding and preservation of the image. Most techniques routinely employed such as wet gate printing actually cover up or obscure damage as opposed to documenting and preserving it. Distortion caused by shrinkage of the old film is largely ignored in current technology capturing only the distorted image itself and forsaking important dimensional information that would allow for a mathematical reconstruction without distortion. The FILMIC project will develop tools to capture that physical information in 3 dimensions. This will allow for data that includes the distortion and warping of the film itself as well as damage to the surface of the film.






## What Will Multi-Spectral Scan Data Offer Us?

Multi-spectral scan data is called a datacube because of its many layers of scans at a variety of narrow spectral light frequencies. The captured light values can range from infrared to ultraviolet. Some of the light is transmissive through the film and some reflects from its surface. The frequency bands can be as narrow as 10 nanometers per color. The limitations of electronic color spaces, glare and other artifacts can be eliminated or reduced to a level that normal broadband lights and RGB can't possibly match.

A datacube can be processed with known techniques and in new ways to give programmers the data they need. For example, they can determine the real chemicals used in the dyes, their real colors. Or apply de-hazing techniques to reverse the effects of aging in the substrates and filter layers that were originally transparent. Or apply topographical techniques to reshape the image to its original shape. Or apply desirable transforms to give viewers the option to see a film as it would have looked in its first release, or as it would look if it were produced today, or at other periods in film history, or as it would look if optimized for the viewer's current environment and display technology. Mathematicians and programmers can achieve so much more with modern computing techniques when they have rich multi-spectral datacubes to work with.

None of those applications, nor applications that no one has yet imagined, are possible with an electronics-oriented RGB two-dimensional scan.

# What Is The FILMIC Project?

The FILMIC project is an open research project that will involve different technologies and techniques in order to create a virtual Multi-spectral data cube that contains condition and physical metadata of motion picture film. Likely it will include the building a prototype film scanning system with multi-spectral light sources from narrow band LEDs. The LEDs can be easily seated in any pattern, quantity, narrow color choices, in a simple hand-held matrix. The LED matrix can be calibrated for each LED's individual brightness. The LED matrix can be programmed to light any number of LEDs at any time to achieve any brightness level per color, and it can be sequenced by a computer to very high speeds. The same LED controller controls the sensor (camera) and shutter. The system will retrofit onto existing film scanners, using their transport portions and simply replacing the RGB two-dimensional scanner. The project will also include the creation of other techniques to measure the film itself in 3D. The project will also explore appropriate file formats for the preservation and use of the data.

Media Matters is making FILMIC a multinational multidisciplinary project. For example, working closely with color scientists and color computing experts at the Norwegian Colour and Visual Computing Laboratory at the Gjøvik University College. Media Matters principals are long-time members of the Society of Motion Picture and Television Engineers and the Association of Moving Image Archivists.

The FILMIC project will be extended to qualified researchers and institutions with an interest in preserving film in the best, most scientific, and extensible ways known to current technology.