Uncovering the secrets of some of the world's first color photographs

April 15 2021, by Tanya Petersen

Credit: Ecole Polytechnique Federale de Lausanne

EPFL researchers have shed new light on one of the earliest color photography techniques, G. Lippmann's Nobel Prize–winning multispectral imaging method.

It is often said that before air travel our skies were bluer yet how, in the 21st century, could we ever know what light and colors were like one hundred years ago? Recently, a group of researchers from EPFL's Audiovisual Communications Laboratory, in the School of Computer and Communication Sciences (IC), had a unique opportunity to try to find out.

Normally hidden treasures locked away in the vaults of a handful of museums, the researchers were offered access to some of the original photographic plates and images of the scientist and inventor Gabriel Lippmann, who won the 1908 Nobel Prize in physics for his method of reproducing colors in photography.

In a paper just published in the *Proceedings of the National Academy of Sciences* (*PNAS*) the authors explain that most photographic techniques take just three measurements, for red, green and blue, however they discovered that Lippmann's historical approach typically captured 26 to 64 spectral samples of information in the visible region. His technique, based on the same interference principles that recently enabled gravitational waves to be detected and which is the foundation of holography and much of modern interferometric imaging, has been almost completely forgotten today.

"These are the earliest multi-spectral light measurements on record so we wondered whether it would be possible to accurately recreate the original light of these historical scenes," said Gilles Baechler, one of the paper's authors, "but the way the photographs were constructed was very particular so we were also really interested in whether we could create digital copies and understand how the technique worked."

The researchers found that the multi-spectral images reflected from a Lippmann plate contained distortions, although the reproduced colors looked accurate to the eye. When they examined the full spectrum reflected from a Lippmann plate, and compared it to the original, they measured a number of inconsistencies, many of which have never been documented, even in modern studies.

"We ended up modeling the full process from the multi-spectral image that you capture, all the way to recording it into the photograph. We were able to capture the light reflected back from it and measure how it differed from the original," explained Baechler. So, could the team replicate century old light?

"With the historic plates there are factors in the process that we just cannot know but because we understood how the light differed we could create an algorithm to get back the original light that was captured. We were able to study invertibility, that is, given a spectrum produced by a Lippmann photograph we know it is possible to undo the distortions and reconstruct the original input spectrum. When we got our hands dirty and made our own plates using the historical process, we were able to verify that the modeling was correct," he continued.

While fully modeling a Nobel-prize-winning imaging technique is of significant interest in its own right, the researchers believe that revisiting Lippmann's photographic technique can inspire new technological developments this century.

The team has already built a prototype of a digital Lippmann camera and is particularly intrigued by the possibilities of multi-spectral image synthesis as well as new multi-spectral camera, printing and display designs.

More information: Gilles Baechler el al., "Shedding light on 19th century spectra by analyzing Lippmann photography," *PNAS* (2021). www.pnas.org/cgi/doi/10.1073/pnas.2008819118

Provided by Ecole Polytechnique Federale de Lausanne