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Computational Imaging for Art investigation and for Neuroscience

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In this talk we provide an overview of two research areas where computational imaging is likely to have an impact. We first focus on the heritage sector which is experiencing a digital revolution driven in part by the increasing use of non-invasive, non-destructive imaging techniques. These new imaging methods provide a way to capture information about an entire painting and can give us information about features at or below the surface of the painting. We focus on Macro X-Ray Fluorescence (XRF) scanning which is a technique for the mapping of chemical elements in paintings. After describing in broad terms the working of this device, a method that can process XRF scanning data from paintings is introduced. The results presented show the ability of our method to detect and separate weak signals related to hidden chemical elements in the paintings. We then discuss results on the Leonardo's "The Virgin of the Rocks"and show that our algorithm is able to reveal, more clearly than ever before, the hidden drawings of a previous composition that Leonardo then abandoned for the painting that we can now see. In the second part of the talk, we focus on two-photon microscopy and neuroscience. Multi-photon microscopy is unparalleled in its ability to image cellular activity and neural circuits, deep in living tissue, at single-cell resolution. In this talk we introduce light-field two-photon microscopy and present a method to localize neurons in 3-D. The method is based on the use of proper sparsity priors, novel optimization strategies and machine learning.

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