Virtual Cleaning of Artworks Using a 1-Dimensional Convolutional Autoencoder

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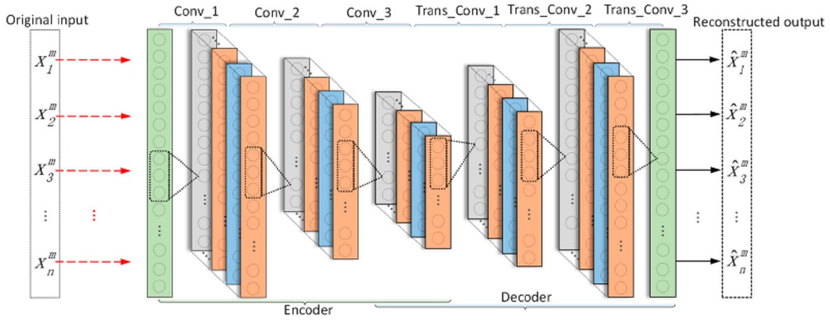
Abstract

- It is well-known that the varnish applied to artwork becomes yellow with time affecting its appearance accordingly. One way to reestablish the original look of the painting is to physically clean the artwork, which is time-consuming and, in some cases, impossible. The simulation of the process of physical cleaning of artwork is referred to as virtual cleaning which could also help the conservators as to whether or not they should clean an artwork. There have been many different approaches to virtually clean an artwork. All of them have some limitations, the low accuracy is the main one. In this paper, a 1-dimensional convolutional autoencoder (1DCA) is proposed to virtually clean artworks in the reflectance domain. Different color charts, such as the Macbeth ColorChecker, and the real hyperspectral imagery of an artwork referred to as 'Haymakers at Montfermeil' (provided graciously by the National Gallery of Art) are used to test the approach and the results are compared with a model called the physics-based model available in the literature.

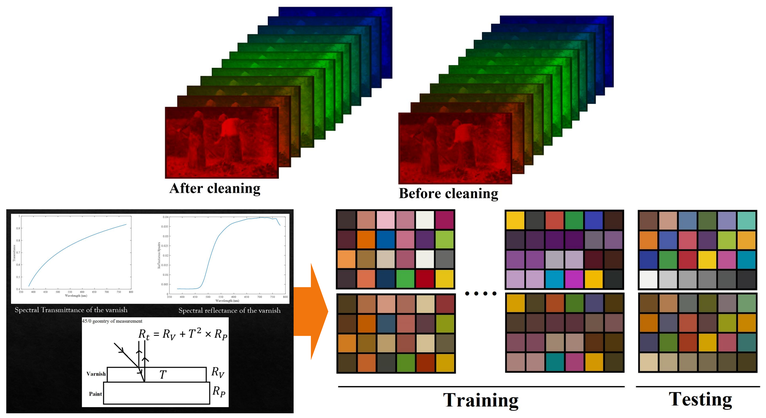
Project Overview

In this work, we plan to virtually clean the artwork using a 1DCA; in order to do that, we need a part of the artwork to be first physically cleaned. Using the hyperspectral imagery belonging to the cleaned and the corresponding uncleaned parts, a relationship is fit using the 1DCA which goes from the uncleaned artwork to a cleaned artwork. The same relationship is then applied to the rest of the painting that is not cleaned yet resulting in a virtually cleaned artwork.

1-Dimensional Convolutional Autoencoder (1DCA)



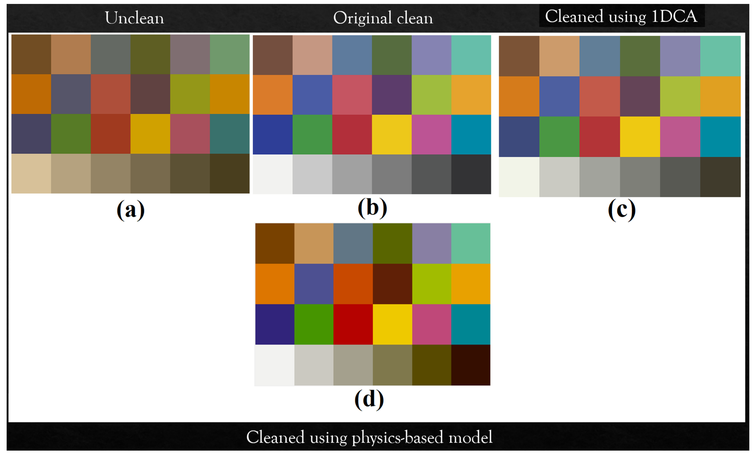
Data



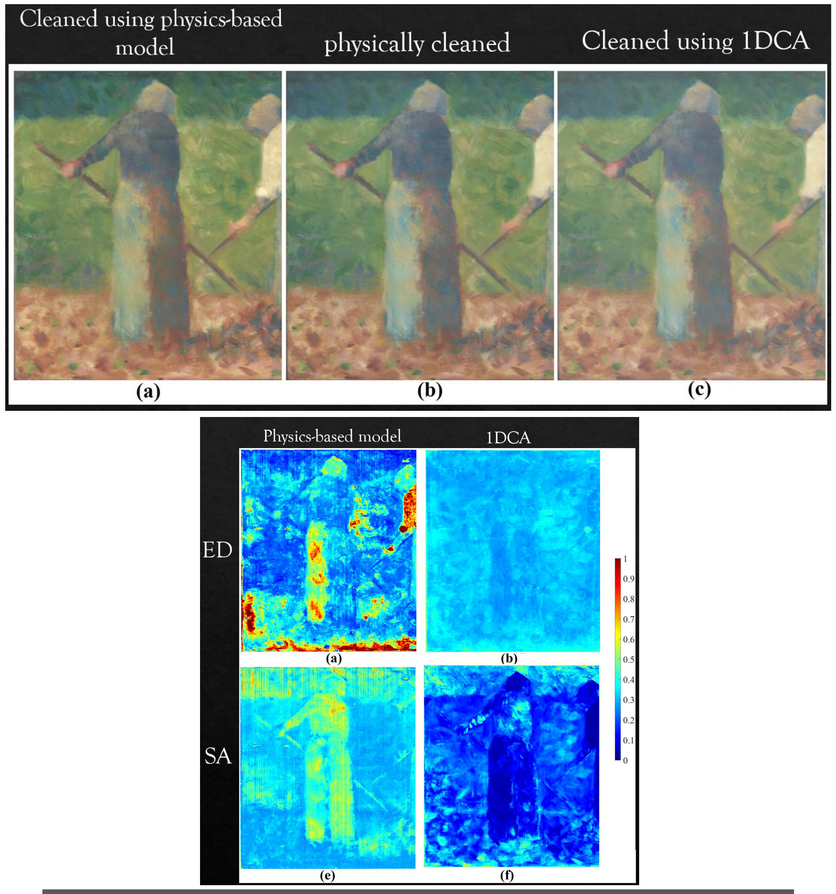
Procedure

- Training the IDCA using the physically cleaned data (in the case of the 'Haymakers', 70% of the painting is used for training and the rest for testing and in the case of the color charts, all the color charts made out of Munsell, NCS, and IT8 datasets are used for training and the Macbeth ColorChecker for testing).
- The error between the virtually cleaned artwork and the physically cleaned one is reported as Euclidean distance (ED) and spectral angle (SA) computed between them.
- The results are compared with those of the physics-based model.

Results



For more information:



Conclusions

- 1DCA outperformed the physics-based model.
- There is a need to have access to a large set of dataset when using 1DCA which makes it useful in cases such as the Dutch Masters, in which, by cleaning only one of the paintings, we could train the 1DCA and then test it on the rest of the (uncleaned) paintings.

Works Cited

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