

# Algorithms Development for Monitoring of Paintings Degradation

**Citation for published version (APA):**

Padaki, A. V. (2023). *Algorithms Development for Monitoring of Paintings Degradation: A computer vision approach to monitor, measure, and detect topography changes in the state of Van Gogh's paintings*. Technische Universiteit Eindhoven.

**Document status and date:**

Published: 06/10/2023

**Document Version:**

Publisher's PDF, also known as Version of Record (includes final page, issue and volume numbers)

**Please check the document version of this publication:**

- A submitted manuscript is the version of the article upon submission and before peer-review. There can be important differences between the submitted version and the official published version of record. People interested in the research are advised to contact the author for the final version of the publication, or visit the DOI to the publisher's website.
- The final author version and the galley proof are versions of the publication after peer review.
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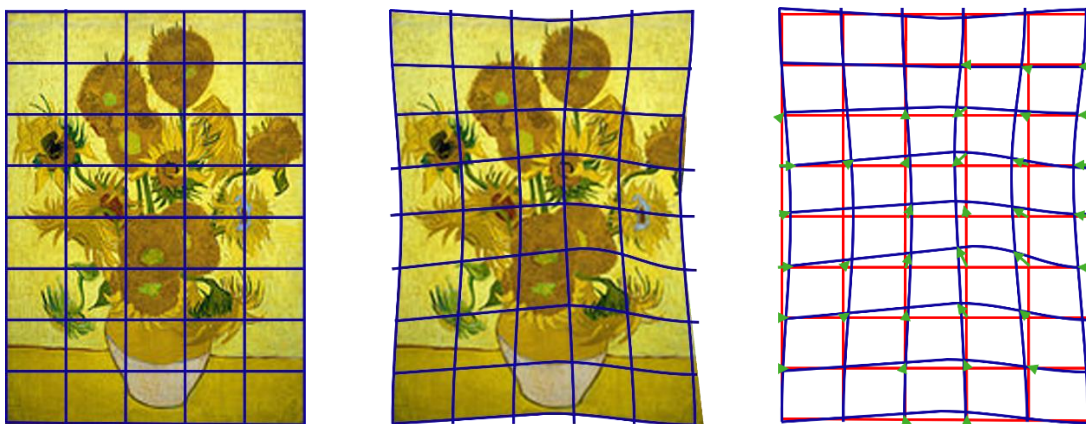
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## **Title: Algorithms Development for Monitoring of Paintings Degradation**

**Sub-Title: A computer vision approach to monitor, measure, and detect topography changes in the physical state of Van Gogh's paintings.**

### **Public Summary:**

The Vincent Van Gogh museum in Amsterdam houses the largest collection (about 200) of Vincent Van Gogh's paintings. The museum also houses paintings from other renowned artists. Van Gogh museum has received over 1.3 million visitors in 2022 and his paintings have inspired millions of people across generations. These paintings are over 100 years old and need careful preservation and restoration efforts, to prolong their life so that they can inspire generations to come. Detecting and documenting changes in these paintings is an important aspect of their preservation and is an enormous challenge. ASML partnered with the Van Gogh Museum as a *Partner in Science* to help the Van Gogh Museum to develop the means to monitor and assess the condition of the paintings. The final outcome of this partnership is twofold: firstly to design and fabricate "*Condition Assessment Scanner (CAS)*", a tool that can measure the changes in the topography of a painting and secondly to develop an "*analysis software package*" for the conservators, that uses the data collected by the CAS to visualise and assess changes. The CAS houses a 3D (XYZ) measurement sensor that can image the topography of a painting one square inch at a time in high-resolution gathering hundreds of images per measurement of a painting.



*Figure 1: Example of a speculated behaviour of a paintings over a period of time from  $t$  to  $t'$ , visualised with the help of empirical knowledge from the conservators. Credits: "Sunflowers", The Van Gogh Museum, Van Gogh Foundation.*

As a part of the "*analysis software package*", Anup working together with ASML developed various algorithms, which are listed below.

1. Image stitching algorithms to compute the topography map of a whole painting.
2. Image registration algorithms to register and compare the two stitched topography maps of the paintings.
3. Change Detection algorithms to find topographical changes in the surface of a painting over a period of time.
4. Neural Network based algorithms to segment cracks, detect pixel-level changes, and classify these changes into different types of cracks.

The first three points contribute to monitor a painting over a period of time by finding changes and the last point contribute to assess the condition of a painting by detecting cracks.