COLOURS TOOL · PERCEIVE LEGACY

De-greening Tool

AI-driven restoration service for Autochrome photographic plates.

Autochrome Restoration | AI Image Restoration | Synthetic Defect Generation | Deep Learning Inpainting | Photographic Heritage Conservation



Fig. 1: Example of a greened (left) and de-greened (right) image, with spotting defects removed using the tool.

OVERVIEW

The Degreening Tool is an AI-driven restoration service developed within the PERCEIVE framework and further aligned with the objectives of the COLOURS project. It addresses one of the most critical conservation issues affecting Autochromes, among the earliest successful colour photography processes, namely “greening” defects caused by material degradation.

Autochromes are extremely fragile and light sensitive; once degraded, their chromatic alterations are often irreversible. Since no ground-truth restored references exist, the tool employs synthetic defect generation to train deep learning models. By analysing real greening patterns, small spot-like stains and larger leakage-style areas with multi-ringed green halos and subtle orange borders, the system creates realistic simulated defects on digitized plates.

Paired datasets (defected vs. clean images) are used to train neural networks with optimization techniques, emphasizing correction of stained regions while preserving original detail. The result is a restoration model capable of removing green artifacts and reconstructing colour balance.

An additional fine-tuned inpainting module refills pale residual areas, ensuring visually coherent, historically respectful digital restoration.

KEY FEATURES

- Synthetic simulation of greening defects based on real degradation patterns
- Randomized generation of spot and large-area leakage defects
- Deep learning restoration network trained on paired datasets
- Adam-based optimization with defect-focused loss weighting
- Generalization from synthetic to real Autochrome damage
- Fine-tuned inpainting for texture and colour re-synthesis
- Non-destructive, reversible digital restoration workflow
- Cloud-ready architecture for large photographic archives

IN PRACTICE: A USER STORY

Claire works in a national photographic archive preserving early 20th-century Autochrome plates. Many images exhibit severe greening: small circular stains and large discoloured patches that obscure faces, skies, and landscapes.

After digitizing a plate at high resolution, Claire uploads the scan to the Cloud and launches the Degreening Tool. The system first analyses the image, identifying areas consistent with known greening characteristics, green halos with faint orange borders and irregular leakage shapes.

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The restoration model, trained on hundreds of synthetic defect pairs, begins processing. Behind the scenes, the network applies parameters learned through iterative optimization, minimizing differences between predicted and clean chromatic structures while preserving fine photographic grain.

Then, Claire sees a preview: the green stains fade, colours rebalance, and details re-emerge. A comparison slider allows her to inspect before-and-after views. In areas where faint colour loss remains, she activates the inpainting module. Fine-tuned on clean Autochrome examples, the model synthesizes subtle textures and colour gradients, blending seamlessly into the original image.

All restoration steps are logged and stored as metadata, ensuring transparency and reproducibility. Claire exports both the restored image and a restoration report for curators and researchers.

Through the Degreening Tool, Claire does not physically alter the fragile plate; instead, she creates a scientifically informed digital surrogate, recovering visual legibility while safeguarding the original artifact.

WHY ON THE CULTURAL HERITAGE CLOUD?

Hosting the Degreening Tool within the ECCCH ensures scalable processing of high-resolution Autochrome scans and secure preservation of both original and restored versions.

Deep learning restoration is computationally intensive and benefits from distributed cloud infrastructure. ECCCH enables centralized storage, version control, and metadata traceability, linking restoration parameters to specific digital assets.

Moreover, synthetic defect datasets and trained models can be shared across institutions, promoting reproducibility and collaborative improvement of algorithms. Cloud deployment ensures sustainability, transparency, and European-wide accessibility for fragile photographic heritage.

WHO CAN USE IT

The Degreening Tool primarily supports photographic archives, conservation laboratories, museums, and research institutions preserving early colour photography. Conservation scientists and imaging specialists benefit from AI-assisted, non-invasive restoration workflows.

Historians of photography and visual culture gain access to clearer, chromatically accurate digital representations of Autochromes. Educators and exhibition curators can present restored images while maintaining full documentation of digital intervention.

Within the ECCCH ecosystem, universities, digital humanities scholars, and SMEs specializing in heritage imaging may adopt and extend the technology.

EXPECTED TIMELINE

Alpha 2026
Core models, institutional testing

Beta 2027
Pilots with partner archives

Release 2028
Production-ready on the ECCCH

Within the PERCEIVE framework, initial research and model prototyping established the synthetic defect generation and baseline restoration networks.

Under the COLOURS project, development will continue toward a stable, cloud-integrated service.

An Alpha version (2026) will consolidate synthetic defect generation pipelines and core restoration models for controlled institutional testing.

A Beta version (2027) will support pilot deployments within partner archives, integrating ECCCH infrastructure for storage, authentication, and collaborative workflows.

By 2028, a production-ready version is expected, fully interoperable within the Cultural Heritage Cloud ecosystem and aligned with COLOURS deliverables.

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All COLOURS tools:
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