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Issues Concerning the Use of Duplication Positives in Digitizing Analogue Films

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Two conceptions of a film work

The current professional dispute about the methodology of digital restoration between filmmaker associations on the one hand (Czech Republic) [1] and film archivists (FIAF) on the other is based on a different understanding of the nature of a film work. Filmmakers understand a film work as a film projection presented to an audience in a cinema hall, as an unquestionable form of performative art. Digital restoration is then interpreted as converting the film work to its original condition, as it was created by the authors and projected from the analogue film medium at the first public premiere. The original form of the film is created through digital restoration via educated guess by qualified experts. These are not difficult to implement, as the basic photographic parameters of film images are the same by default (black and white levels, grayscale, color range).

Archivists also recognise digital restoration as the conversion of a film to its original form, but with the presence of some contemporary degradation, which they see as a natural part of the age of film material. They explain that digital restoration must include material degradation ("lacunae" - the excessive non-original parts of the image - typical tonal shifts) [2] caused by the ageing of color-forming pigments and disintegration of the film basis. Here they appreciate the "poetry of destruction" [3] as a later added but intrinsic part of the time-degraded artifact stored in the film box. They understand this "art of destruction" as a fundamental condition for the existence of film history. Without it, film history wouldn't exist and therefore it is more important than the film itself. If the material degradation of film archival materials is a process that varies over time, the fact of digitizing a certain momentary stage of this process is highly questionable, even untenable. The authenticity of these degradations is no longer valid on the second day, and with the passing of the years, it becomes more and more distant from the authenticity of the present state of degradation of the original film material.

Filmmakers do not understand the film work as a physical material but as a repeatable live performance projected from this material in any way. They start from the premise that contemporary digital technology makes it possible to digitally restore the work and thus petrify the degradation of analogue film materials once and for all.

Two types of image sources

The expert dispute is also complemented by the different requirements of the two parties for the use of image sources for the digitization of the film work. The authors wish the films to be digitized in the highest possible quality, ideally in the quality of the original negatives taken with a film camera. According to the DRA method [4], the aim is not to change the work and not to create its new version, but a digital original fixed in another physical material, in zeros and ones somehow recorded.

Archivists prefer to use duplication prints, i.e., second-generation positive archival material made from original negatives that reflect the original character of the image as determined by the cinematographer in a moderately degraded form. But they forget the fact that the cinematographer first created a tonally and color-balanced positive print directly from the original negative in the film laboratory. That is how the first high quality distribution print, often shown at film premieres, is produced. Only after the completion of this cinematographer's work, which had to be approved by the director and producer of the film, was the original negative copied further into second-generation safeguarding or archival positive prints (so-called Intermediates). However, these cannot be projected. In order to make another distribution print from them, this material had to be further copied into the already three-generation Intermediate negative.

What is the difference between a second-generation positive distribution print and a second-generation safeguarding positive Intermediate? There is a different image in both, but the latter was not approved by the authors because they did not see it on the screen. It was created as a mere safeguarding image that tolerates the required technological image deviations as a virtue out of necessity. In Czechoslovakia, for example, distribution prints, due to their small number, were always made directly from the original negative. The duplication positive was produced only for the purpose of safeguarding the original negative against damage, and the third-generation copied duplication negative was produced from it only for the purpose of selling the films abroad. Often the film laboratory produced the safeguarding duplication positive already after the third so-called equalising print, i.e., at the time, when the production of the final equalised print was not yet completed by the cinematographer. Sometimes the cinematographers would not finish color equalisation until the 7th or 9th equalising print. The duplication positive therefore rarely contains the final state of the cinematographer's authorial input. The film laboratory was motivated to do so by the fear of damaging the negative and also by the knowledge that this duplication positive would not be used in practice anyway. Later archival intentions were not addressed by the laboratory as these were determined by the original negative. The replacement of the original negative for second-generation duplication prints is therefore very questionable, specifically in Czech conditions. It is also worth noting that the pigmentation degradations taking place

in the original negative are different from those in the safeguarding duplication prints. The older the film, the greater the difference and the greater the risk of different digital versions of the film.

Codes of ethics and recommendations

In the past, many codes of ethics have been created to defend the position of the author's work and its integrity. The motif of altering the original work by adding new visual elements, whether in the form of archival material destructions or authorial enhancements, led to the creation of the DRA Methodology Code of Ethics, which adopted many of the initiatives from archival codes of ethics [5] and prohibited both archivists and authors from making additional changes to a film work. In the DRA methodology, this is addressed by the existence of an advisory expert group in which the living cinematographer, sound master, and director are members but do not have a dominant position.

A new study published in the report of the Technical Commission of the International Federation of Film Archives (FIAF) reflects this issue as follows: *The Digital Statement Part III Image Restoration, Manipulation, Treatment, and Ethics,* by Robert Byrne, Caroline Fournier, Anne Gant, and Ulrich Ruedel [6], states on the one hand that films should be digitized from the highest quality sources based on careful selection: *"Each project may have a range of source materials to work from, such as exhibition prints, duplicate negatives, fine grain positives, original camera negatives, small gauge reduction prints, later generation duplicate prints, magnetic media, etc. Careful selection of the materials, if you have a choice, will have a great influence on all the restoration decisions that follow"*

In the same document, they recommend that second-generation prints, i.e., those that have often undergone an incomplete photographic process and are therefore ethically unsuitable for restoration, are preferred for digitization. It literally says: *"It may seem counterintuitive, but original camera negatives may not be the most desirable source material for digital film restoration, especially when the final result will not be recorded back to photochemical film. High-resolution scans of camera negatives may produce the sharper image desired by commercial enterprises but are highly problematic from an ethical perspective. In addition to presenting an inauthentic look and sharpness, scanned camera negatives reveal details that were never visible in release prints."*

This opinion goes on to make claims that are incomprehensible to film production professionals: *"Scanned camera negatives also do not include any artistic or technical processes that led to the finished release prints, and they lack the historical and aesthetic character of the film as it was originally presented. Conversely, distribution prints, if they are in good condition and of good photographic quality, have considerable advantages as source material since the print, or prints, possess characteristics not present in the negatives. These characteristics include film grain, color grading, applied color systems (tinting, toning, stencil-coloring), aesthetics of particular film stocks, special effects compositing, optical effects, and other aesthetic and historical characteristics."*

What is the most appropriate source to digitize from?

According to the DRA Method, the digital restorer selects from the best available sources and only in the case of the impossibility or non-existence of such media can films be digitized from multi-generation prints and, in critical cases, from distribution prints. The preceding lines of the FIAF report point to ignorance of the technological procedures of film production. FIAF's claims that prints are more suitable for digitization than the original camera negative, which does not contain *"any artistic or technical processes that led to the ... aesthetic character of the film"* or *"the print, or prints, possess characteristics not present in the negatives. These characteristics include film grain, colour grading",* are among the most pernicious and absurd of them all.

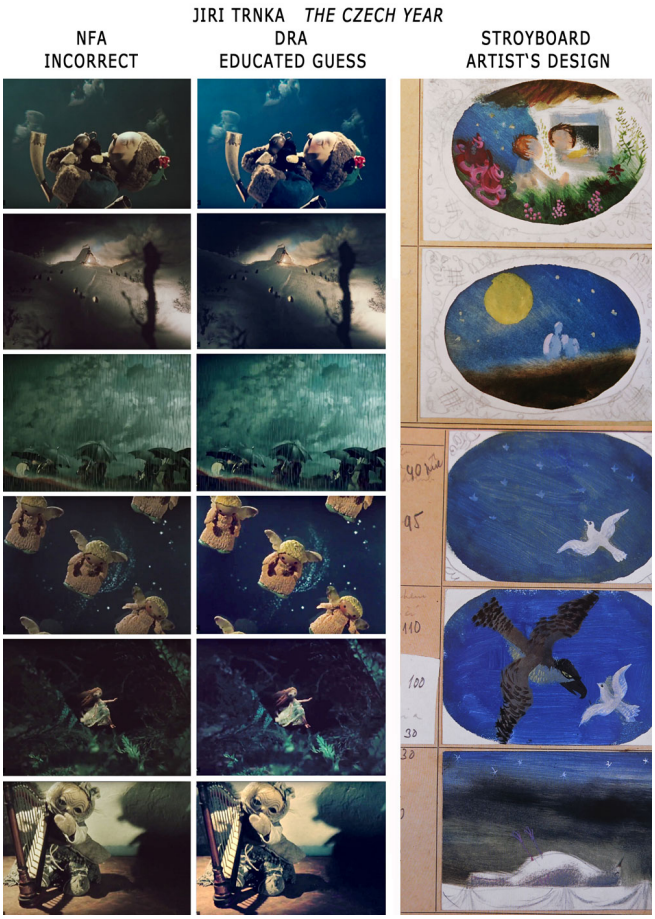

Figure 1 *Three samplers of the film "The Czech Year", made by director Jiří Trnka (1947). On the left, there is a wrong digitization made by the National Film Archive (NFA) in Hungarian laboratories Magyár Nemzeti Filmlap (2014). In the middle, there is a DRA sampler, showing how the film should look like and on the right a sampler of artist's design, part of working storyboard to this film. We can see differences between NFA's and Jiří Trnka's design (left vs. right). The author was director of the film and storyboard artist in one person.*

Let us look at two examples of the results of unprofessional digital restoration of Czech films, which were carried out by archivists themselves, mostly outside the Czech Republic.

The first practical example

In 2014, the National Film Archive in Prague (NFA) produced twelve low-quality digitized films in the Hungarian Magyár Nemzeti Filmlap laboratory, as part of the Norwegian Funds project. For the first time, the digitization was deliberately carried out without the required participation of an expert restoration team of cinematographers and sound masters. The restoration was led only by the curator and supervising colorist, who applied the "poetic destruction" input to the digitization and created unacceptable new versions of the films. The expert evaluation committee convened at the Ministry of Culture of the Czech Republic issued a verdict which read as follows: *"...films cannot be considered restored..."* There was financial damage and infringement of personal copyrights. New versions of these films were made with the active input of the archivists' demand for degradation. It must be added that to this day there has been no correction of these vulgar digitized films, which are further distributed by the NFA around the world without the consent of the representatives of the authors of these films. Let's look at the example of the film *Špalíček* [*The Czech Year*], 1947, by director Jiří Trnka, where we can compare the appearance of the final degraded digitized image with the DRA educated guess and the storyboard artwork of the film's late director and storyboard artist Jiří Trnka. The typical blue color as an aesthetic quality of Trnka's pictorial designs does not appear at all in the NFA's digitized version.

Second practical example

In 2021, there was a renewed attempt by the archivists to exclude an expert group of cinematographers and sound masters from the digital restoration process on the occasion of the digitization of the film by director Vojtěch Jasný *When the Cat Comes*. The archivists incorrectly selected a second-generation duplication print and took it to the prestigious Italian restoration laboratory L'Immagine Ritrovata in Bologna.

The original negative of the film was in perfect condition, but was intentionally not used. There was also a DRA sampler made from the original negative, which was produced by the National Cultural Identity Research Project (NAKI) as a reference sampler for the DRA methodology. It was only necessary to take it to Italy and use it. But this did not happen, and so digitization has again produced an untenable result.

Although the NFA's restoration report [7] states similarly to the NAKI - DRA restoration report that the original negative *"allows... further use for digitization, provided that proper handling is applied and digitization technique designed for working with historical film materials is used"* However, it states differently that: *"The original negative of an image contains the greatest amount of photographic information and detail of all materials, and has the highest color and density range. Compared to positive materials, the grain is sharp and contrasty in a way that film viewers could never see when projected and is distracting in the image. The use of the original negative as a source material entails the* ***necessity of a greater number of digital interventions into the original structure of the image,*** *hence deviating from the photographic properties of the source film material ... The use of the Intermediate positive as a source material for digitization* ***will*** *thus* ***allow to minimise digital interference in the structure of the image, such as reducing the film grain to the level usual for positive prints.*** *Conclusion: Therefore, an Intermediate positive was chosen as the starting material for the digitization of the image"*

Figure 2 *DRA Sampler of the film "When the Cat Comes", left: Digital Facsimile of Reference Print (DFRP) and right: DRA from the original negative (59 years old).*

It is therefore a deliberate misinterpretation of the recommendations of the FIAF Technical Commission report, as we have read above, and a completely unprofessional attitude denying the existence of all previously successful digitizations made from original negatives.

Let's compare the two digitization processes on two shots from the film *When the Cat Comes*, taken on a sunny day in the square in Telč in a standard exposure situation. We extract large details from these images that reveal the true grain structure and, in the selected image passage, the reproduced contrast rendition. This necessarily corresponds to the grain size.

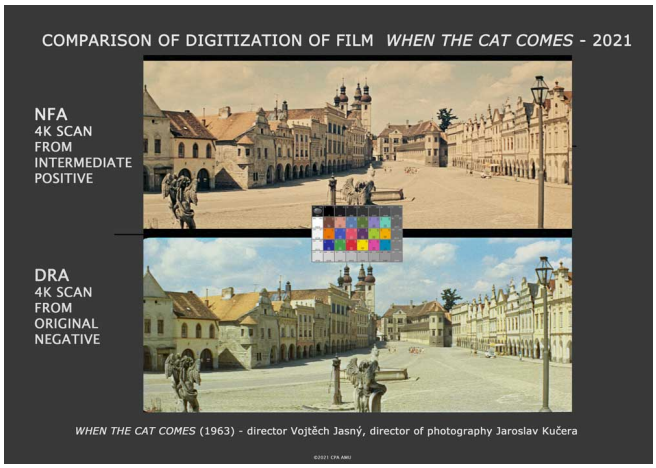

Figure 3 *Comparison sampler 1 of digitized film "When the Cat Comes", by director Vojtěch Jasný. Above, the NFA Final Master DCP made from Eastman Intermediate Positive; below, the DRA made from Eastman Original Negative. Scene of a long shot of the city of Telč square with noon summer sunlight.*

Figure 4 *Comparison sampler 2 of digitized film "When the Cat Comes", by director Vojtěch Jasný. Above, the NFA Final Master DCP made from Eastman Intermediate Positive; below, the DRA made from Eastman Original Negative. Scene with children walking in a square in the city of Telč.*

Let us now take a closer look at a comparison of the three image sources of the film *When the Cat Comes*. The first sample on the left shows a 4K scan of the original camera negative and the digitally restored DRA created from it. A facsimile of a 59-year-old contemporary reference prints is seen in the centre of the test image. This copy is very color degraded, darkened and color shifted to yellow-green. On the right, there is a 4K digital version produced by the NFA from a duplication print. The DRA image was slightly brightened and yellow-green shade was removed compared to the facsimile of the reference print. The NFA's digital version was not brightened, but instead increased contrast was used, which "baked in" details in critically dark areas and enhanced the subjective grain of the image. This noticeable adjustment of contrast is visible, for example, in the shadows on the church steeples, in the windows, or in the boy's hair. Here we see disproportionate blackening and removal of image information that was visible in the reference print. The image on the NFA's digital version is therefore noticeably sharper, more contrasty and with an inappropriately shifted color, both in comparison with the facsimile of the AGFACOLOR reference print and the DRA restored original EASTMAN KODAK negative. The image behaves similarly even in the second sample, which is a shot of the marching children carrying the magic cat.

Figure 5 *DRA Sampler of "When the Cat Comes", by director Vojtěch Jasný. Left: DRA sampler from the original negative. Middle: Digital Facsimile of Reference Print (DFRP). Right: NFA's digitized version of the film made in the L'Immagine Ritrovata laboratory in Bologna, Italy.*

1) 4K restored digital version from a scan of the original negative of the film *When the Cat Comes* (DRA method)

2 - 4K digital facsimile of the analogue reference print of the film *When the Cat Comes*

3 - 4K digital version from a scan of a second-generation duplication positive made from the original negative of the film *When the Cat Comes* (NFA) at the time of the film's creation.

Digital restoration requires professional know-how and years of experience, which tell us that a film image is affected by several parameters at once. You can't take out a single parameter and not react to changes in the other parameters, because they are all affected at once. For example, by increasing the contrast, the visibility of the grain is subjectively increased. Image texture is one of the four basic image parameters, along with color rendering, brightness, and contrast scales. In the case of a film image, it is represented by kinetic intermittent grain. The original grain from the original negative, which can be clearly seen in the large detail of the boy's face in the second sample, was copied in the same way into both the fine-grained AGFACOLOR positive print and the fine-grained EASTMAN INTERMEDIATE duplication print. The information in the NFA's restoration report is clearly misleading and again shows an ignorance of film technology. The image texture on the Intermediate positive copies the grain from the original negative as conspicuously as it does on the positive distribution print. The NFA's claimed different finer grain from "positive prints", creating a different looking film image aesthetic as allegedly viewed by cinema audiences, is not seen here. On the contrary, the highlighted tonal contrast makes the original grain of the original negative appear more pronounced in the NFA's digital version.

We will point to the structural image grain parameter once more through a simultaneous image test made on black and white EASTMAN 35mm 5222 DOUBLE X material by students of the film school (FAMU, Prague, 2022). The test shows that film materials work with the image texture today as they always did in the past, which is confirmed by the years of experience of cinematographers-contemporaries. The extremely fine grain of the positive distribution print (ORWO B&W) is due to the extremely low sensitivity. The test images convince us that the distinctive grain clusters of the original negative are directly copied into the fine-grained positive print without alteration. The grain texture of the original negative will appear in the positive print in the same way as it is visible when the original negative is scanned with a high-resolution film scanner.

Subtle defocusing of an image scanned from a positive print is caused by the scanner's inability to detect the fine grain of the positive print. The image therefore looks slightly out of focus. When we project a positive distribution print in a conventional film projection onto a screen, this fine grain is visible to the human eye. The image is projected through the classical optical system of the projector lens and the human eye sees the subtle details in the form of sharpness of the image and registers the grain by observing the intermittent movement of the grain clusters exposed in the individual fields. Thus, the NFA's argument about using a duplication print to simulate the unfocused appearance of distribution prints is incorrect.

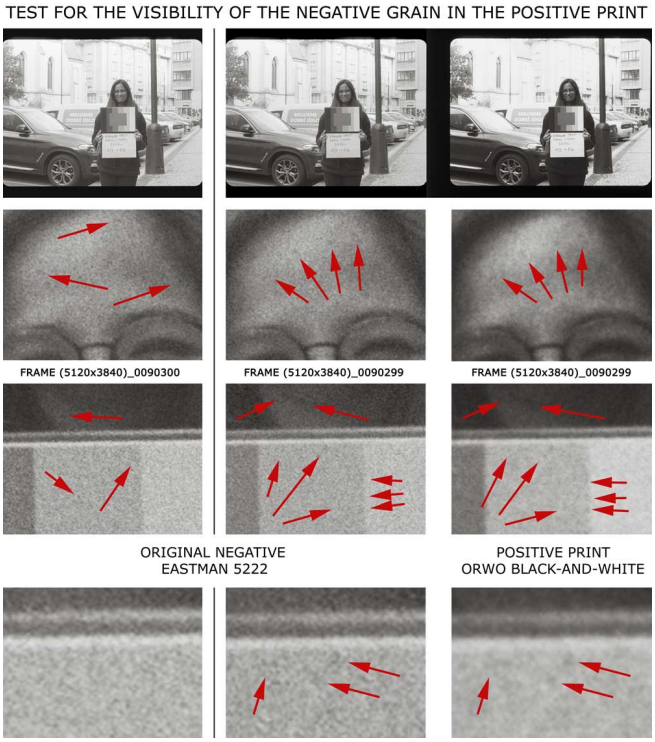

Figure 6 *DRA Reference test patterns in the black and white EASTMAN original negative 5222 Double X (on the left and in the middle) and ORWO positive print (on the right) of the sensitometric test of FAMU students made in 2021 in Prague. The grey reference patches are easily measured using specialised densitometers. The picture shows that film grain is re-recorded from the original negative to the positive print without changes. The left and middle frames constitute two neighbouring frames, so we see that grains are in different positions.*

This test was made with a Lasergraphic Director 10K scanner at 5K resolution at the Czech Television in Prague. The NFA's argument in its restoration report claiming that: *"Grain* [of the original negative, note by the author] *is sharp and contrasty compared to positive materials in a way that viewers could never see when projected, and is distracting in the image."* is refuted.

But why archivists refuse to acknowledge the original negative as an unequivocally authentic source, the type of which used to often be chosen by the cinematographer, also taking into account the structural aesthetic expression of the image, is a real mystery to us. Why would cinematographers in the past, and even today, so carefully select the original negative for filming also according to the nature of the grain, if the grain of these negatives was not visible in positive prints? The grain was of course visible in the prints, sometimes even amplified by cinematographers through non-standard development processes to become a more distinctive part of the visual form of the film image.

But let's ask another question, what projection conditions do we actually have in mind? We are well aware that each cinema hall was equipped with different kinds of projectors, different screen sizes, and the audience watched the films from different angles and sat at different distances from the screen. They have seen or not seen the grain in various ways out of focus. Therefore, it is not possible to establish a standard rule or parameter for what the audience could actually see during a film performance. Added to this is the fact that each print was different, subject to the individual variability of photochemical processing in film laboratories. Parameters of standard viewing conditions do not work in practice at all; we can find them only in some calibrated projections of film laboratories when respecting the correct viewing location (recommended viewing distance and angle). All it takes is an uncleaned projection image area in front of a modern digital projector in a multiplex: and viewers will not see a sharp image nor also any grain.

Ten years of experience with the digital restoration of films produced with the EASTMAN KODAK system (original negative) copied to ORWO/AGFA (distribution positive) has shown us that archival period positive prints are always more degraded than the original negatives. They are always darker and color-shifted to yellow-green. Therefore, the DRA samples of the film *When the Cat Comes* were lightened and stripped of the yellow-green coloration compared to the AGFACOLOR reference print. The NFA's digital version was not brightened at all and the yellow-green tone was replaced by an orange tone. Where this unnatural orange tone came from, we can only guess. Who is right? The expert group of experienced cinematographers [8] or the inexperienced and apparently not sufficiently qualified young NFA archivists? Cinematographers actually shot on these materials and know the color character of the KODAK/AGFA/ORWO image from personal experience. The film's director of photography Jaroslav Kučera and director Vojtěch Jasný would never have allowed such an orange print to be screened at the film's premiere.

Another serious error is that the original process, namely the EASTMAN KODAK original negative copied directly into an AGFACOLOR positive print was mistakenly replaced by the EASTMAN KODAK original negative copied into an EASTMAN KODAK duplication positive. However, it was never converted directly to AGFACOLOR prints. If only for the sole reason that it is itself a positive print and not a negative. The colors and contrast conversion in the KODAK duplication positive are naturally shifted differently, so the necessary information from the original negative for a quality restoration is not available in this material. This difference increases with the age of both materials. So how is it possible to simulate the AGFACOLOR "look" from EASTMAN KODAK Intermediate positive? The result shows, only barely.

Responsible approach

In addition to digital restoration, the money spent should also be used to preserve the source scanned data (Digital Source Master), i.e., the intact master scans of the entire film to protect it from further photochemical image degradation process. The FIAF technical material on page 4 reads as follows: *"To a certain extent, and adhering to the principle of reversibility, preserving the raw scan is more important than preserving the completed restoration. It is possible to redo a restoration, but you may never be able to re-capture a raw scan, especially in the case of rare or deteriorating materials."* But how tenable is this argument, if master scans are not taken from the highest quality image source, which is the original negative? By scanning second-generation degraded prints, this requirement loses credibility. (!!!)

Digital restoration is not meant to serve as a technical documentation of a period, but it should serve for the benefit of preserving the living work for the future living world. The film director did not make the film for archivists and their research into film history or the poetry of destruction, but for the audience. Films carry an important message that should be preserved in a clearly visible form consistent with the intentions of the filmmakers. The DRA methodology produces impeccable results resulting in an authorised original film that matches the original look of the film as closely as possible.

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[6] https://www.fiafnet.org/pages/E-Resources/Digital-Statement-part-III.html,*https://www.fiafnet.org/pages/E-Resources/Technical-Commission-Resources.html*

[7] NFA's Restoration Report for the film *When the Cat Comes*: https://arl.nfa.cz/arl-nfa/cs/detail-nfa_un_cat-256918-Dokumentace-digitalniho-restaurovani-filmu-Az-prijde-kocour-Vojtech-Jasny-1963/?disprec=8&iset=1

[8] The members of the DRA expert group were cinematographers Jaromír Šofr, Jiří Šimůnek, Ivan Vít, contemporaries of the creators of the film *When the Cat Comes*, who knew this technology perfectly.