

Maintaining analog film projection in the digital age.

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Most film archives have entered the digital projection era. Restored film elements are routinely being screened in a digital format, though long-term storage is still predominantly based on photochemical film. However, most of the collections consist of analog film prints, and just a tiny fraction of this material is available in digital screening formats.

“Preserve – then show” is the golden rule within the film archive community. For decades, preservation has been seen as the most important task for film archives, since access relies upon it. The challenges and costs associated with film restoration is well known for all readers of this journal. Education and knowledge has been built up over the years, and archivists and preservationists alike have learned to master the required techniques. Film laboratories dedicated to restoration have played a major role in securing the characteristics of the sound and image, and the end result has been entirely dependent on the archivists’ understanding for and familiarity with the unique texture, contrast and sharpness of the films.

This accumulation of in-house knowledge, experience and development of best practices has few parallels in the projection booth of the very same film archives: The in-house knowledge of film projection equipment has been rather arbitrary: Maintenance and improvement of the projection and sound equipment have typically been outsourced to local companies primarily servicing regular commercial cinemas, with entirely different needs.

Cinema engineers understanding analogue projection technology represent a dying breed. This has and will continue to change the way we think about projection and which resources we allocate to our projection departments.

No more “free rides”

With the boom of multiplex cinemas in the 1980s and 1990s, the cost of film projectors, sound processors, film screens and projection lenses went down due to a highly competitive market. Film archives have been lucky to benefit from the comparatively low-cost equipment, which has lasted for years, without large budget requirements for maintenance and upgrades.

However, the knowledge of the technical supplier has often been restricted to the needs of the local multiplex, which have little to do with the particular needs of archive cinemas: The concept of change-over installations is fundamentally different from non-rewind set-ups, and the fact that colour-matched lamp-house reflectors for proper presentation of both black & white and colour film are needed is generally unknown. Equally unknown to the average cinema technician are heritage film and sound formats: If the Academy aspect ratio isn't odd enough, what about the Movietone aspect ratio of 1.19:1? Is it realistic to expect that a local cinema engineer is aware of the requirement of a large variety of silent film apertures, variable film speed options (14 fps – 30 fps) and the need for both white light and red light analog optical soundheads?

The symbiotic relationship between archive screening rooms and commercial cinemas may have contributed to sub-standard archive presentations, but at least it contributed to low cost and a widely available service. As the analogue projection industry is wiped out, none of these benefits will be on offer, and the archives must adjust accordingly.

Thousands of film projectors have been abandoned or recycled all over the world because of the digital roll out in commercial cinemas. Film projector manufacturers are either out of business or have gone all digital. Some film archives have probably managed to get hold of projectors cheaply from a local multiplex. After all, the equipment was fairly new (ten years on average), and will come to good use. But ten years of commercial film screenings in a multiplex with 12 to 14 hours operation a day, all year around, is not something you necessarily would like to project your precious archival prints on. While projectors may be cheaply available, their quality and suitability for archive cinemas are

unknown, and the knowledge about their setup and installation is extremely scarce.

Raise your analogue standards

Film archive personnel is often very enthusiastic when installing their 2k or 4k digital projector for the first time. The image is bright, it has sharp edges and may well meet SMPTE standards for digital film projection. Could this perceived improvement be related to the fact that 35mm film projection is no longer the premiere film format?

Historically, directors and cinematographers have been the quality control department of many cinemas. They have given feedback to the projection department if "something is wrong", thereby raising awareness of a problem with e.g. a lens or a misaligned mirror. In many cases, an unhappy film-maker has been the initiator for the technical department of a cinema to invest in new and better equipment.

Digital projection is now the premiere format, the performance of your analog equipment is now entirely up to the archive.

With the introduction of digital projection in film archives, many film classics are now widely available for cinemathèque screenings. Even so, your analog film projection needs to meet the same high standards. It is unfair and historically incorrect to screen analog films on film projectors with burnt out projection lenses from the 1980-ies or 1990-ies, misaligned lamp-houses, incorrect color temperature (or difference in color temperature between each projector in a change-over operation).

Your patrons are now also more acutely aware of imperfections of film projection. Especially flicker issues caused by a bad rectifier or old xenon bulb can ruin the presentation. The shutter in itself will cause a very obvious difference, since the patrons are no longer used to seeing this when going to the movies. Adding lamp flicker to the ubiquitous 48 Hz or 72 Hz shutter flicker rate makes the anomaly unnecessarily more obvious.

A correctly cut aperture plate is also very important, as soft edges around the image may appear more obvious than in the past, since

the anomaly is exclusive to film.

Choices and strategies

The first step for an archive wishing to improve the analogue projection is to make a technical review of the installed projectors, sound processor and other technical equipment, such as rewinders.

Which are the formats you intend to screen, and for how long? Ten years, 25 years or 100 years? Are some formats more important than others? If you have a large collection of 16mm film prints, you may want to actively search for the optimum choice of 16mm projectors. If your archive consists of wide screen titles of the 1950-ies and 1960-ies, you may want to look into equipment for magnetic sound reproduction and 70mm.

What choice or brand of film projector to choose is not an easy question. It is important to be aware that the age of the projector has nothing to do with its performance. It may well be that a 50 year old projector is performing better with prints in not perfect shape than a ten year old projector designed for the commercial multiplex market.

Since most projectors have been thrown away forever, and since buying a brand new high-quality projector is difficult (or impossible), my recommendation would be to choose a brand which has been fairly widespread in your country – or in your part of the world. The more projectors in existence, the easier it will be to get parts. If your currently installed projector is of a rare breed with difficult access to parts, now could be the time to change the equipment. It will only get more difficult in the future.

As important as proper and well-maintained equipment is, equally important is how it is installed and calibrated. You ought to locate a service technician or company, which specialize or are willing to become your technical partner. For how long can this person or company supply you with their knowledge and service? If short term, you may want to increase your budget for upgrades for analog equipment immediately.

Establishing contact with a machine shop is also highly important. Some parts will never be available, and you will have to custom-

make parts. Even with today's 3D printing techniques, you will have to find a specialist company who understands your need, and has the interest and capacity to make a one-off part, or at least a small quantity parts. Ideally, your service technician should have the skills to supervise the machine shop when making the parts.

The mechanical part of a film projector is one thing. Another important issue is the projector control electronics. The older the electronics, the higher the probability that you will experience a show stopper. You may want to consider changing the whole electric wiring and control of your projectors.

Are the motors getting unusually warm and should be overhauled or changed? How old are our rectifiers, and does the current ripple exceed the maximum of 4 percent?

There are still some very high quality film projectors out there in the field – some are more reliant on complex electronics than others. Only time will tell which brand of projectors will prove to be more reliable. and it is hard to judge if a projector with a mechanical intermittent unit will be easier to service in 2035 than one with an electronic unit.

My advise will be to make the installation in such way that it will be possible to maintain it as long as possible, and with electronics that are "off-the-shelf" and found in other fields of business as well. Try to avoid custom-made solutions, which are undocumented and only possible to service by the person who installed it!

The Norwegian approach

Over the past few years, the Norwegian Film Institute has established some long-term goals for our analog film projection. Our experiences may be beneficial for other archives as well.

We have chosen old projectors from around 1960 to suit our needs. In our large auditorium, we have chosen Philips DP70/ NorelcoAA projectors. With our passion for widescreen films from the 1950-ies and 1960-ies, and since 70mm film projection is particularly celebrated in our bi-annual 70mm festival, the choice was limited to a few projector models. Philips is known to be gentle to old and shrunken films, which is very important when running

precious prints from all over the world. The other key factor when making this decision, is that it a very widely known projector, installed in all parts of the world. When installing older equipment it is absolutely necessary to have a large stock of spares. We have managed to rescue five complete projectors, which we can use for spare parts. We have also sourced spare parts (new stock with years on the supplier shelves) from all over the world.

The performance of our DP70s has been great over the years. However, in the past two to three years we have made many improvements.

Our first upgrade project was linked to our need for a dual analog sound reader. Especially Dolby A soundtracks from the 1980-ies sounded harsh and brutal when using a modern red light reader. We managed to get hold of a pair of Kinoton basement readers combined for Dolby Digital and red light analogue. The readers were sent to Rosbeek Techniek in the Netherlands – a specialist company with in-depth knowledge of historic film formats, projectors and sound formats. The readers where rebuilt with parts from Kinoton and custom made LEDs.

The audio quality was dramatically improved. When you hear an old film print intended for white light reading, and with a flick of switch change to red light reading, you will not understand how you could accept the performance of the red light reader is the past.

The positive outcome of this project was a good reason to improve other aspects of our film projection when it is still possible. It is very hard to find skilled technicians with the passion and heart for quality at this level. Our next step was to change as many gears as possible with the new spare parts we had acquired from all over the world. New Maltese intermittent movements were installed in each projector. Why should the new parts be lying on the shelf for years and waiting for the parts in the projector to totally wear out? We concluded: Let's change them now, and let our patrons get the benefit immediately.

We focused on what was visible for our audience, and the new gears provided less image vibration.

Next step up for improvement was the projection lenses. We already had really good projection lenses with the “red line” from Isco Optics (Isco Ultra Star HD Plus) in all formats. However, when we compared with the Schneider Premiere lens (with variable f-stop) in an A-B-test, we were convinced that this is the best projection lens for 35mm film projection currently available.

For years after seeing this, we wanted to invest in Schneider Premier lenses, and it was on top of our investment plan. When we finally got the funding, Schneider had stopped making them. That is the sad reality when it comes to maintaining analog film projection these days. The search for Premiere lenses with the correct focal lengths for our needs took a long time and led to a high cost, but it was surely worth the wait. Together with custom-made lens holders (to allow some slight lens shift if necessary), the result was astonishing.

The variable f-stop of the Premiere range also gave us an added benefit: The rectifiers could be set on a fixed level, and adjusting the f-stop to get 16 foot lamberts in each format was finally possible.

Flicker is something, which my eyes get more and more wary of. In a digital projector, there is no flicker at all. The bulbs for a digital projector has to be of a tighter tolerance level than a xenon bulb for film projection. With film projection you have a flicker from the shutter anyway, so some flicker from the bulb can be accepted without the bulb being regarded out of specs. For our screenings of Christopher Nolan’s “Interstellar” in 70mm, we changed our xenon bulbs to bulbs intended for a digital projector. Adapters had to be custom-made to fit our lamp houses. When combined with electronic IREM EX-series rectifiers yielding low ripple, the result is excellent: The only flicker we now can observe is the ubiquitous 48 Hz from the shutter.

Our latest update was performed this past summer. The cables and control of the projectors had been upgraded and changed several times since the 1960-ies. Some of the brittle internal cables insulated with asbestos were still in use. We decided to rebuild the whole control system, getting rid of old cabling which

easily could short circuit and become a show stopper. We also opted to replace the motors, as they were getting excessively warm from time to time. Rosbeek Techniek came up with a direct-drive motor, very small (but powerful). The direct-drive motor improved vibrations compared to the old belt-drive type, and will hence reduce the wear on our gears in the projection head.

The result of all these improvements is that we have never before had as good analog film projection as we have now. Our only regret is that we should have done this years ago, when we had filmmakers in for critical pre-view screenings on a weekly basis. But with renewed interest from our younger audience and students, with the wish for the "original film experience", it is worth the investment.

Improvements are also required to take care of precious film prints. With this in mind, we opted for the development of a new film spool. Looking at our own collection of reels/spools, it was a mix and match of film spools from the 1950-ies till the 1990-ies. Most film spools have been designed for commercial use, with an inner core diameter much too small for change-over operation of archive film prints. With input from the technical manager of the Swedish Film Institute and our own team, the "Archival film spool" was born. With a large inner core diameter, holding up to 850 meter of acetate film, and with a weight of less than 1000 grammes, it is a small, but very important improvement in film projection equipment. It will fit any projector spindle size (built to order).

Final remarks

I recommend all archives to act now. The knowledge (and equipment) is disappearing at a staggering high rate. You may be lucky to have companies and individuals around, which still can provide you with the skills and experience necessary to meet the standards for screening and critical viewing rooms. You may want to cooperate with other archives in your region, to save cost when custom-making parts or save travel costs if you have to fly in specialist from abroad.

All this comes at a cost cost. Traditionally, film projection has been under-finanzed and under-prioritised in most archives. The heads of the archival institutions need to prioritise technical

improvements in analog film projection in their budgets before it is too late. It is our obligations as film archives, as true and alive film museums, to keep projecting analog film prints in the best possible way, as long as we can without endangering our precious film prints, for our generation, and the next.

Nitrate did wait. Analog projection may not.