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DIGITALIZATION AND AUDIO MASTERING (RESTORATION) IN INSTITUTE OF ARTSTUDIES – SOFIA

Abstract. I present a part of our work at the audio archive. Focused on some mastering conceptions and video references, I will try to give you approach how we do “the process”. In this paper I will explain:

- I. Presentation of existing vinyl's in our archive
- II. A few words about BAARTI project which is the main financial “backbone”.
- III. Our hardware (Laser Turntable, hardware ELP declicker with 88 kHz high-grade AD converter, Vacuum Cleaner for LP's, TC Electronics professional ASIO compatible audio interface etc.)
- IV. The main (last) part is dedicated to the concrete processing applications like Crackle, Hiss and Pops removal, multiband compression, RMS level optimization, pitch correction and similar. The workflow is Samplitude Master Edition supported by Waves Restoration - Mastering plug ins and UAD card with master bundle.

The conclusion polemize about the question “Do we need to do all this processing?” or better leave it untouched. Also a few words about audio digital database, data storage, back up and perspective's.

Keywords: Institute of Art Studies – Sofia, Audio Digitalization and Restoration, Laser Turntable, BAARTI project, audio mastering concepts, Alexander Yanakiev.

I

Institute of Art possesses a rich collection of old records (records for scientific purposes and commercial boards) - a unique and quantity and content. It's a collection of about 1500 plates on which the recordings were made during the first half of the XX century. So far they are not treated (restored, digitized, databased) and examined in its entirety (except for single publications - eg. V. Dimov. "Towards the Study of recorded music in Bulgaria in the first half of the twentieth century: the archives and collections, Bulgarian Musicology , XXIX, 2005 / 1:144–172).

Some of these records are carriers of the preserved most ancient records of traditional music made for scientific purposes in Bulgaria. They are unique because they have single copies - have entered the field and not reproduction. There are also more than 800 records recorded by the recording companies Presto and Telefunken during the period 1938–1953, according to their size they are three types (high, middle and small) according to the material – metal, glass, PVC, etc., according to the manufacturing company – "Presto," Detsilit ", "Suprafon ", "Audiodisk ", "Rekorddisk. Among the earliest and most valuable records are made by Rayna Katsarova registrations of traditional music in 1938 (along with American Esther Johnson - Sofia, Sofia, Rodopi) and 1939 (Northeastern Bulgaria - document recordings of V Festival, Varna). Early recordings as a traditional music in Bulgaria does not store any other institution (archives of the Folklore Institute, for example, Bulgarian traditional music recorded over the past three decades).

These are about 600 records from the first half of the twentieth century - shellac, 78 speed, Bulgarian and foreign companies. The collection began to be collected and cataloged over 60 years of the twentieth century, but the earliest artifacts are from her first decade of the century - records of companies "Gramophone Concert Record", Favorit record ", "Diploma ", "Pate. Valuable this collection is that it stores the earliest recordings of Bulgarian

traditional, artistic and popular music. Among the oldest records are those of the music of Leybgvardeyskiya NTSV Regiment (actually the first symphony orchestra in Bulgaria) records one of the founders of opera in Bulgaria, Stoyan Mihaylov, records one of the most famous orchestras post office "Shop" - all period from 1904–1910 onwards; early recordings of a traditional instruments and ensembles of brass and military bands, operetta and popular tunes of singers - 20 and 30 years of the twentieth century, recordings of music of ethnic groups - 40 - and they are 50 years of the twentieth century collection contains records documenting the origin of the music industry and music media in Bulgaria - Bulgarian companies "Patel-Simonaviya / Later-Simonaviya Orpheus", "London Record", "Microphone" "Crystal", "Balkan", "Harp" and others. As the quantity and content of the commercial collection records of the Institute of Art is unique - some of the plates do not occur in such prominent collections in Bulgaria (BNR Gold Fund, the Permanent Collection at the history of exposure to radio of Sofia University).¹

There are also approximately 3,000 musical recordings on a tape. The oldest recorded music in Bulgaria is currently not accessible to public because it has not been preserved and processed using contemporary advanced technological methods. The Folk Music Archive of the Institute of Art Studies documents Bulgaria's folkloric heritage, which has been collected by ethno-musicologists for almost a century. Written materials number over 250,000 pages, while there are over 750 films and about 900 video cassettes.²

II. Bulgarian Art Archives and Advanced Research Technologies (BAAART)

Project director: Assoc. Prof. Alexander Yanakiev, DS:

“Time has taken its toll; thus, some of the archive materials are threatened by the aging of the different materials they are kept on: paper, photographic, plates and materials, recording and film materials, gramophone records, etc. Using these materials as they now exist is becoming more and more difficult. For all of these reasons, the managing body of the institute has developed a program for preservation, protection and modern presentation of these valuable assets; the Bulgarian Art Archives. Thanks to a grant provided by the Ministry of Education and Science for the support and presentation of the archives, the Institute can now use advanced research technologies. Starting at the beginning of 2007, the two-year project Bulgarian Art Archives and Advanced Research Technologies (BAAART) has been underway. The project emphasizes the necessity for the collection, selection, processing and preservation of the rapidly vanishing traces of Bulgarian art culture, which is part of a national and European heritage. The highly qualified team from the Institute of Arts Studies has undertaken this activity. The process of preservation both of the already existing art archives, belonging to the institute and other organizations, and of important contemporary art events includes urgent recording, scanning and digitalization. In addition, collection of books related to the project, periodicals, discs, audio-visual records, etc., is necessary for the supply and actualization of the archives. Creation of such an interdisciplinary database in the fields of fine arts, music, theatre and cinema aims at the provision of better conditions for using the archives, including organization of a computer info centre as well as internet access for

¹ Dimov Vencislav. "Studies of recorded music in Bulgaria during the first half of XX century: Archives and collections". *Bulgarian Musicology* (2005/1).

² Aleksander Yanakiev, *Advances in Bulgarian Science* 2007/1

scholars, students and all those interested in the field of art studies. The latter might increase the networking and collaboration not only between all scholars and specialists in art studies in Bulgaria from different institutions, but also might assist in popularization and increase of foreign scholars' interest in Bulgarian artistic heritage, resulting in new international joint research. The project also contributes to the development of better career opportunities for young scholars and specialists in art studies. According to the project's two—year schedule of planned activities, it will be possible to process only part of the existing archives of the institute, as well as the archives of other organizations, personal archives and archives of contemporary art events. Work on the further development of the archives as well as their public popularization might continue during the following years. The main aims of this project are to digitalize the following materials in a short period of time:

- currently existing archives
- to initiate creation of archives of important contemporary art events Realization of these difficult tasks is facilitated by the fact that an enormous amount of data collected by the research fellows of the Institute of Art Studies already exists in four fields:
 1. fine arts (ancient, medieval, and modern art)
 2. music (folklore, liturgical songs, contemporary music)
 3. theatre (20th century, contemporary theatre)
 4. cinema (fiction movies, documentary films, animation)

These archives are divided into:

- photo-archives,
- bibliographical catalogues,
- textual archives,
- audiovisual archives,
- micro-film archive

Japan has already provided the institute with unique equipment for re-recording of records, the ELP Laser Turntable LT-ZXRC with an ELP declicker.

Acquired equipment and performed activities via BAARTI

- Laser Turntable ELP Laser Turntable LT-2XRC and accessories
- Large format scanner - Kodak Filemaster+ A 2 book scanner
- Work stations Hobit – the working and visitors places are equipped with these tools
- VPN network created
- Special software was made for the creation of the integrated data base
- 1500 records from the archive of the Institute of Art Studies were digitalized,
- 55 000 pages of old, valuable and endangered publications were scanned
- Digitalized with the help of a photo-camera were 10 000 materials concerning different arts from newspapers and magazines ...“

III. Our Audio hardware

(Laser turntable, hardware ELP declicker with 88 kHz high-grade AD converter, vacuum cleaner for LP's, TC electronics professional ASIO compatible audio interface, Professional reference monitors KRK VXT 6 etc.)

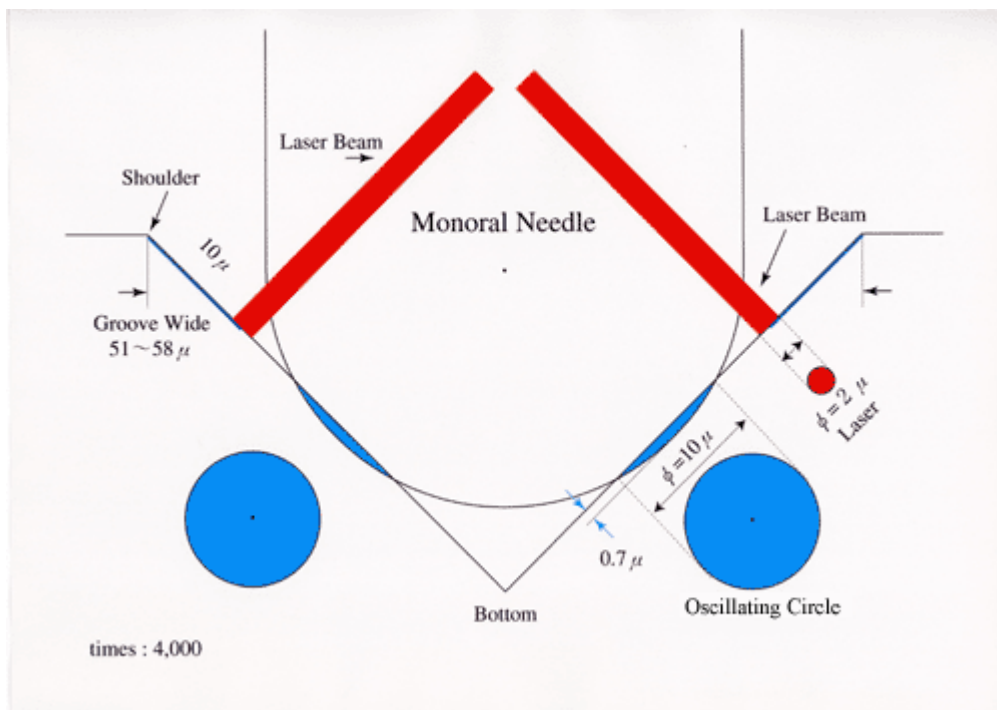
The performance of the Laser Turntable means "No Needle, No Wear TM." The LT features an absolutely contact-free optical pickup system. Play a record thousands of times with no damage to the record. The Laser Turntable allows to:

- Play Vinyl Records without damaging them.
- Discover great new analog sound in Vinyl Records.
- Play damaged Records with better results than a needle.
- Have the convenience, control, and safety of playing Vinyl Records just like a modern CD player (the record is contained inside the machine, and with a remote control you can click to play any track while the LT tells you the elapsed & remaining times).

Laser Turntable has Five Laser Beams :

- The first two beams aim at the left and right shoulders of the groove for tracking.
- The next two read the stereo sound at 10 microns below the shoulder (the standard position).
- The final beam maintains the height between the laser head and the surface of record, to manage thicker or warped records.

Laser Reads New Audio Information - the same audio information is engraved from the shoulder to the bottom of a record groove. Audio information read by the laser is 10 microns below the shoulder. Therefore, the laser is picking up audio information which never been touched/damaged by a needle. It plays the virgin audio information on the groove *without an digitization*.



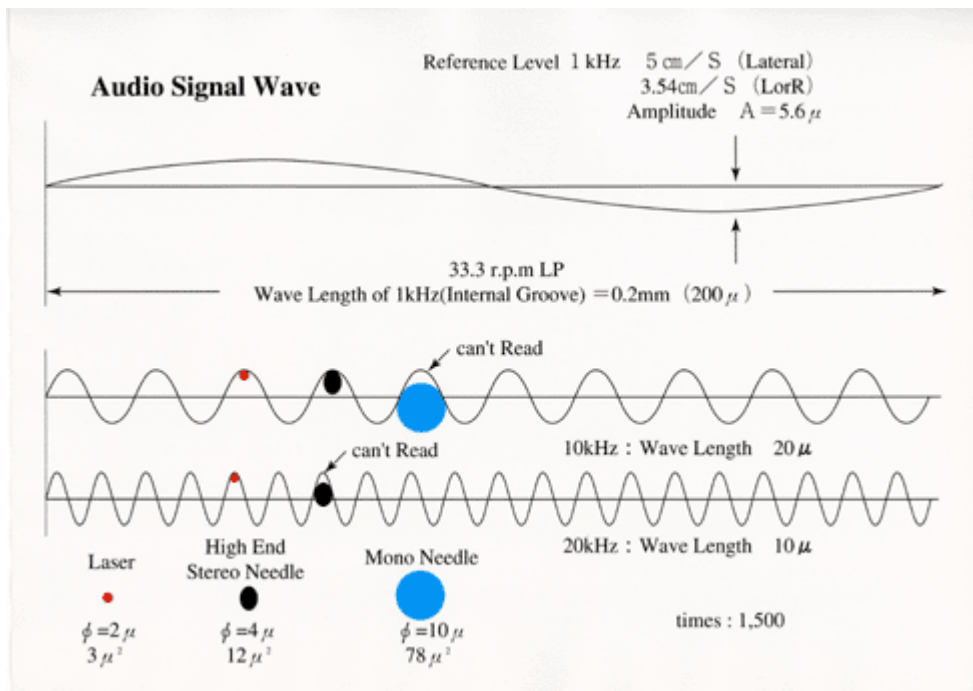
This diagram illustrates how the tiny laser beams from the LT read the walls of the groove compared to a standard monaural stylus.

Laser Beam Position is Easily Adjusted. Occasionally, audio information read at the standard laser position is seriously damaged due to wear from a very big needle. In this instance, you can adjust the laser position up or down using a button on the LT's front panel in order to enjoy better sound quality (this is called the VSO system).

Left and Right Lasers are mechanically-independent. These lasers can reproduce true superior stereo separation, greater than the capability of a cutter at all frequencies.

LT has Continuous Turntable Speed Control. Control 0.1 RPM steps throughout the 30 to 50 RPM range for LP's and 45's on the LT-1LRC. The LT-11XRC and LT-1XRC models that play 78's also offer a 0.2 rpm step control over the 60 to 90 rpm range.

The incident area of the laser beam on the groove is only a fourth the contact area of the best stereo needle and twenty-six times smaller than a mono needle (see below). That's why the laser beam reads everything – including dirt and dust in addition to the audio signal – in the groove, so the vinyl record must be absolutely clean and free of debris.



The incident area of the laser beam on the groove is only a fourth the contact area of the best stereo needle and twenty-six times smaller than a mono needle.

The laser beam travels to the wall of the groove and back. The reflection angle is transferred to the audio signal, meaning that the LT maintains analog sound through the entire process, without any digitization. As a result, the LT cannot differentiate between an audio signal or dirt on the record. To keep your records clean, we recommend a record vacuum cleaner.

Any kind of cartridge contacts a record groove, so it cannot reproduce sound without some coloration. Additionally, cantilever resonance, moving coils and magnets, inertia and mass, and tone arm resonance all produce their own sound coloration. Therefore, some cartridges may be suited to jazz or classical music. However, the LT has no contact and therefore no coloration added, so the audio reproduction is as close as possible to the master tape.

Feedback is typically caused by sound from your speakers (or from elsewhere) reaching the turntable and mechanically picking up the vibrations, to be amplified again. No needle "singing." The LP is safely in a drawer and the laser reads only the undulations of the groove. No need for elaborate vibration isolation pads and "gizmos." The LT will not hear outside noises such as footsteps on the floor, door slamming, or other vibrations in the area.

Plays Warped and Rippled Records (up to 5mm deviation). In some cases, the LT plays even broken records when all the pieces are placed on a tray without tape or glue.

The ELP LT is the perfect choice for:

- *National, State & Local Universities/Schools, Libraries, Record Repositories, Musical Societies*

...as well as...

- *Professional Studios...* to transfer records to digital for commercial release.
- *Archivists...* to restore old and valuable recordings.
- *Institutions...* to do research on rare recordings and preserve the content by transferring to another medium.
- *Serious Record Collectors...* who want the best music reproduction without damaging the record.
- *Hobbyists...* to transfer records to CD, and who especially want every nuance and detail from the recording.
- *Record Stores...* which sell rare records and wish to demonstrate the disc quality to a buyer.

The ELP declicker:



- Real-time noise reduction of clicks and crackle (impulse noise), but not hiss (broadband noise).
- No other hardware is required.
- Click/crackle sensitivity is continuously variable using a single rotary control. When the sensitivity is set to "minimum" there will be minimum noise reduction and negligible effect on the signal.
- Bypass allows the user to leave the ELP declicker in the signal path with no noise reduction.
- Bypass is easily switched on and off with a front-panel control.
- Bypass operates in two modes:
- Analog Mode: Analog output is connected directly to the analog input with no AD-DA conversion. There will be an audible "Glitch" when switching Bypass on or off in this mode.
- Glitch-Free mode: The bypass is implemented by switching off the de-click process. The signal continues to pass through analog-digital-analog, but no processing is performed. There is no glitch when switching bypass on or off in this mode.
- Analog RCA stereo inputs connect directly to phono preamplifier or ELP ELT-10 outputs

- Analog RCA stereo outputs connect directly to line-level preamp or integrated amplifier
- Digital S/PDIF coax or optical (TOSLINK) outputs connect directly to computer or DAT
- Sample Rate: 44.1 kHz or 88.2 kHz, user selectable
- Word length: 24-bit

The digitalization process is going through the 24-bit/192kHz TC Konnekt 8 (our audio interface). It gives us superior stability, a perfectly aligned digital signal flow, no artifacts and no digital jitter...and this is all due to the TC developed DICE II digital interface chip.

IMPACT™ – Integrated Mic PreAmp Circuit Technology. TC is renowned for its mic preamps. Konnekt comes with IMPACT™ preamps, giving us the very best possibilities to make a mic recording that almost emanates pure gold.

IV. Mastering – restoration process

In the book “Manual of analog sound Restoration” by Peter Copeland, (this is written for sound archive of the British Library), the author *categorical mark* “It is aimed primarily at the professional archivist transferring them to conserve them, and it is generally assumed that the purpose is TO PRESERVE THE ORIGINAL SOUND.” In sound engineering field, there is really two basic opinions: one guild is upholder the conception to preserve the original sound as at is (when it comes to old archives), and the other guild thing that’s it is better to do some processing, which can optimize the audio quality. The priority of all Audio processes in institute of Art study is to transfer the data in best possible quality and to optimize it for using it in our databases. That’s why, we choose Samplitude as main audio workstation:

1. Works undestructive with audio material – that’s mean that all transferred data are saved without any processing in separate folder.
2. Real time - Object editing mode – give us possibility to edit little part of audio material without destruct or process the selected audio in the back up folder
3. Possibility for real time variable pitch shifting which is so, so useful with old reel to reel tapes and old gramophone plates, where the speed is not constant. Actually I use this function only in case of request.
4. Make ID3 tags and CD audio text + full professional red book CD audio mastering.

The real process that we do can’t be named restoration, because this means that I should study the original record machines, to meter their audio parameters and trying to recover the absolute original sound. It’s not necessary and it takes long time. Also, It cannot be exactly say that it’s mastering, because our goal is not to make them “radio ready”. What we do is optimization, which give the students and researchers adequate audio levels (loudness) and noise free archive material. Of course, don’t forget that Samplitude “remember” the audio file “as at is” and every subjective mistake is correctable in time.

Here are some steps of audio “mastering” process after transfer (for example 78 speed vinyl record):

1. Usually they are mono, but there are some differences in Left and Right Chanel which I want to preserve. But, if the difference is in level and it’s more than 2 decibels – I correct it. I never do mono export, the result file is stereo 320 kbps mp3 file.
2. Get a noise print to make a quality 24 bit noise reduction

3. Un Crackle and declicker process. Don't forget that the transfer is made through hardware declicker – it means that it is second declick process and I do it only if necessary.
4. Filter with High pass at 40, 60, 80 or 100 Hz – depends on program material.
5. Pitch, time correction – if necessary. Sometimes the laser beam jumps in next groove – I have to correct it.
6. Slightly compression with light parameters for little peak reduction and level optimization – if necessary.
7. Final Limiter – for achieving RMS loudness level of – 12 db
8. Manual level adjustment of different song.
9. Timing corrections – fade ins, and fade outs. Track indicators for beginning and endings. Put ID3 tags (usually the tags are job of database operators)
10. Export to mp3

After all of this processes, Samplitude has ability to bypass the signal. It's so useful when it comes to compare the processed with the original source file. The sound engineers' ear has to make a judgment.

References

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