The background of the page is a photograph of a modern building with a light-colored facade and a dark, cantilevered section. Bare trees with some red leaves are in the foreground, and a clear blue sky is visible. The text is overlaid on this image.

International Conference Audio Archiving, Preservation and Restoration

National Audio Visual Conservation Center,
Culpeper, VA, USA

28–30 June, 2018

CONFERENCE REPORT

INTRODUCTION

Tucked away in the foothills of the Blue Ridge Mountains, the quaint town of Culpeper, Virginia is home to the U.S. Library of Congress National Audiovisual Conservation Center (NAVCC) Packard Campus. From June 28–30, 2018, the town was teeming with audio archivists, preservationists, and engineers, as well as material scientists, academics, record label executives, and others who gathered from around the world to take part in the Audio Engineering Society International Conference on Audio Archiving, Preservation & Restoration. The AES has not held a conference on audio archiving since 2001 in Budapest, Hungary. A testament to the audio archiving community's hunger for information about innovations and new technologies for preserving historic audio, this conference sold out well in advance. Attendees were eager to learn from one another and share current research around best practices, metadata standards, chemical science, preservation methodologies, and issues in archiving emerging audio formats.

This conference, chaired by former AES President John

Kravit with incoming AES President Nadja Wallaszkovitz and David Ackerman sharing duties as program cochairs, and IASA President Toby Seay and Konrad Strauss serving as papers cochairs, attracted experts and attendees from Japan, Korea, Saudi Arabia, Qatar, India, Sudan, Nigeria, England, Sweden, Finland, Denmark, Belgium, Germany, Austria, Switzerland, Italy, France, Spain, Mexico, Canada, and all regions of the USA. Notably, five former or future presidents of the AES were in attendance (Kravit and Wallaszkovitz as well as Jim Anderson, Alex Case, and Jim Kaiser). Many attendees also presented their own research, which elevated the discussions both during panels and presentations and while socializing over coffee breaks and meals.

Attendees were graciously welcomed by the NAVCC and their staff, who shared their facilities and wisdom over the course of the conference. The NAVCC provides underground storage for the Library of Congress's extensive collection of audio, video, and film collections—nearly 3.5 million recordings in all. Panels and presentations took place in the beautifully restored 205-seat

theater that evoked the look and feel of classic movie palaces. Concurrent sessions were held in nearby executive meeting rooms, and an abundance of locally sourced snacks made for excellent noshing and socializing during coffee breaks between presentations.

PRE-CONFERENCE TECH TOUR OF THE NAVCC

Bright and early on the first day of the conference, attendees who had signed up in advance were treated to an extensive three-hour tour of the NAVCC facilities, including processing areas, storage vaults, and audio, video, and film preservation labs. The Library's collection covers over 110 years of recorded sound and nearly every audio format, from cylinders to CDs to born-digital materials.

Rooms are equipped with Ampex ATR 104, Studer A807, A810 and A820, and Otari MX-5050, MTR-12 and MTR-15 tape decks, Simon Yorke Designs analogue precision disk transcription system and

Technics SP-15 turntables with Stanton 500 and Shure V15 cartridges and dozens of styli to choose from, and an Archeophone cylinder playback machine. The LOC also holds one of the first IRENE 2D machines ever produced—a system of optical playback of grooved media used primarily for cracked or damaged cylinders and discs. In the A1 lab, all audio is digitized one-to-one. The A2 lab is equipped with a ring of Studer tape machines for parallel transfers of ½" and ¼" reel-to-reel tapes. In the cassette room, conference attendees were given a sneak peak of a new cassette playback deck that can digitize both sides of the tape simultaneously at up to 4x speed. Used primarily for oral histories or other spoken



LIBRARY OF CONGRESS
PACKARD CAMPUS
AUDIO VISUAL CONSERVATION



word content, this playback machine will greatly increase the amount of audio digitized and preserved.

The LOC's Data Center houses the Long Term Storage Infrastructure (LTSI) and receives data from over fifty digitizing stations throughout the NAVCC. The digital content is stored on protected spinning discs until two copies are made. One copy is stored on site and the other at an offsite facility. The disk arrays (RAID6 protection) are capable of storing over 150 TB of data. Data is stored on Oracle Hierarchical Storage Management Platform (OHSM), verified with checksums.

The LOC's "museum room" was a big hit among this crowd, who squeezed in to gawk at a Berliner gramophone, a vintage Scully lathe, wire playback machines, old Revox and Ampex suitcase tape machines, Dictaphones, classic RCA microphones, Pultec EQs and more.

KEYNOTE

AES Fellow and AES Gold Medal recipient Bob Ludwig gave a rousing keynote entitled "The Formats of My Career (All of Them Need Archiving)." Ludwig has been mastering records since the late 1960s, which means he's ridden the many waves of format changes in music production and distribution. His firsthand experience in creating master recordings—on 78rpm discs, compact cassettes, 1630s, DATs, PMCDs, and now, high-resolution BWFs, multichannel masters, and MQA—offers invaluable perspective on the longevity of formats and the challenges in preserving them. For perspective, 78 rpm discs were the primary distribution format for nearly 50 years. How long did CDs rule the market? Ludwig's presentation spurred conversations among conference goers around the need for more education on preserving obsolete digital formats such as early Pro Tools sessions, content from synthesizers and samplers, mixes and masters saved on Jaz drives, Zip discs, exabytes, AIT tapes, and floppies.

DAY 1

The NAVCC tour and the keynote by Bob Ludwig started off the conference on a high note and would have been worth the price of admission alone. However, there were still three full days of programming and events to attend. Following lunch provided by the LOC (with sweeping views of the Blue Ridge mountains), attendees had the opportunity to learn more about the chemical science behind magnetic tape degradation. Andrew R. Davis, Eric

B. Monroe, and Fenella G. France shared their research around the chemistry of polyurethane-based audio tapes before and after baking, with the goal of improving methods for nondestructive identification of sticky tapes. Federica Bressan, Antonio Rodá, and Roberta Bertani presented their methodology and initial results of a study examining the effects of thermal treatment on the audio signal on magnetic tapes using a series of chemical analyses and audio analyses. Bressan and Bertani also presented on the effects of thermal treatment on tape elasticity. Thermal treatment is expected to restore the elasticity of damaged tapes, making them more resistant to mechanical stress and less prone to breakage.

Continuing on this theme, Tom Fine moderated a panel featuring Richard Hess, Charles Richardson, and Dietrich Schüller on the real-world challenges of playing back aging polyester tapes, particularly the phenomenon known as "sticky shed." One of the purposes of their discussion was to differentiate between sticky shed syndrome and other soft binder syndromes so that practitioners can utilize the proper remediation technique without trial and error.

Following the first of many coffee breaks in which attendees were treated with locally made cupcakes, cookies, pies, and other sweets, the conference continued with more in-depth research into magnetic tape playback. Jamie Howarth and John Chester, of Plangent Process, offered a comprehensive overview of their process of utilizing the record bias to provide a time reference for time base correction and azimuth adjustment. Richard Hess shared a paper on the quantification of azimuth errors in order to examine what can and cannot be addressed in postprocessing.

Moving from magnetic tape to grooved media, George Blood then shared four large data sets involving playback of 78 rpm discs, showing how it is possible to determine with reasonably high accuracy the correlation between correct stylus size and record label in pre-1923 acoustic discs. However, determining proper playback speed remains much more difficult.

Stefano Cavaglieri gave a tutorial on pre-emphasis and de-emphasis in disk transfer and the related frequency vs. amplitude

response. As with so many of these workshops and panels, the goal was to provide a solid foundation to help practitioners choose and apply the correct de-emphasis in the digital and analog domains.

The first day wrapped up with a presentation by Peter Kuhnle and Tobias Rapp on the advantages of digital de-emphasis of gramophone



John Krivit (left) with Bob Ludwig and his certificate of appreciation



From left, Michael Romanowski, Brad McCoy, and Chuck Ainley



The band gathers round the horn of a cylinder recording machine.

recordings and how applying the emphasis curve in the digital realm may offer greater choices and superior results in digital noise reduction and in achieving intended tonal balance.

After a full day of panels, attendees were treated to a concert in the exquisite Packard Campus Theater by Cole Quest and his City Pickers, who performed a mix of originals and songs written by Cole's grandfather, Woody Guthrie. Then, the band gathered strategically around the horn of a wax cylinder recording machine (the banjo player had to stand on a stool behind the others), and Jerry Fabris, Curator of the Thomas A. Edison Historical Site recorded a live cylinder recording of them performing Guthrie's "This Land Is Your Land," with added verses written by Cole Quest and slating by Bruno Caruso, the nephew of Enrico Caruso. The audience was rapt. For those who work with cylinders or other legacy recording formats, hearing the playback immediately after the live recording was a rare opportunity to understand first-hand the frequency and dynamic limitations of a cylinder recording.

DAY 2

The second day of the AES AAP&R conference opened with a workshop on expert disk transfer techniques, headed by Stefano Cavaglieri, Jean-Hugues Chenot, and incoming AES President Nadja Wallaszkovits. Starting with an explanation of the possibilities and limitations of conventional mechanical transfer, these panelists then led a discussion about optical transfer methods and technologies and their use in dealing with broken, delaminated, or otherwise unplayable discs.

The LOC's Peter Alyea offered a deeper look into the use of imaging in grooved media playback. Though still evolving as a preservation technique, systems such as IRENE provide an opportunity to evaluate and quantify the differences between traditional stylus playback and optical playback and develop new preservation standards.

Indiana University's Mike Casey, Dan Figurelli and Melissa Widzinski outlined principles used by IU's Media Digitization and Preservation Initiative to create a workflow for preservation of lacquer discs, including adhering to best practices, limiting physical stress to the carrier, keeping signal flow simple, and maintaining the option of making subjective judgments. They offered practical, implementable solutions for abiding by these principles, including techniques like utilizing a microscope to evaluate grooves, cleaning discs by hand, dealing with tracking problems, and more.

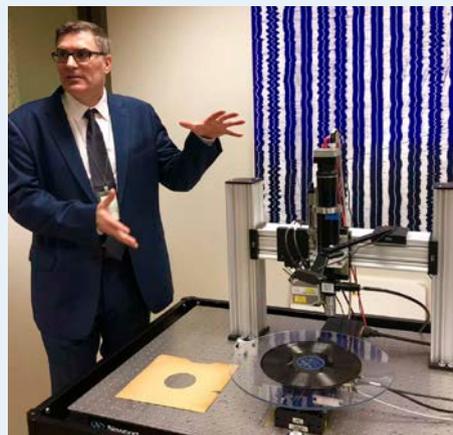
During the second day, attendees had the opportunity to attend in-depth tours of the LOC's audio labs. Choosing from a list of topics that included Disk and Problematic Media, Cylinders, Media Prep, Tape Playback, Parallel Transfers, Multitrack and Surround, IRENE, and Historical Audio Equipment on Display, attendees gathered into the audio labs while LOC engineers shared their workflows and best practices as well as hot tips about where to purchase stylus cleaner, how to manually align an off-center disk, and where to source 78 rpm styli in the wake of recent news that Shure is discontinuing phono cartridge manufacturing in the summer of 2018. (A common challenge for audio preservationists is sourcing parts for legacy playback machines).



Wax cylinder blanks



Program cochair Nadja Wallaszkovits with Brad McCoy



Peter Alyea discusses IRENE.



Panel on the preservation of multitrack recordings.

A highlight of Day 2: renowned producer Jack Douglas (John Lennon, Aerosmith) was joined by Tobey Seay (Drexel University and current IASA President), Nathan Chandler (University of Calgary), Rob Friedrich (LOC), Kelly Pribble (Iron Mountain) and George Massenburg (McGill University) to talk about the challenge of archiving multitrack recordings. Multitrack recordings on magnetic tape have been accumulating since the 1950s. By now there are tens of thousands of multitrack masters in need of preservation, to say nothing of the numbers of born-digital multitrack recordings created in now-obsolete DAWs. Panelists discussed the challenges of maintaining and calibrating multitrack playback machines but also emphasized the incredible value of these recordings for educational purposes. Attendees were treated to a peek behind the scenes of the recording of Earth Wind and Fire's "September" (did you know there was a french horn line that didn't make the final mix?) and John Lennon's "Crippled Inside" from Imagine.

Day 2 wrapped up with a screening of films from the LOC's collection in the Theater. This theater is one of only five in the country capable of projecting original nitrate film. Conference attendees got to see and hear one of the earliest known sound films (from 1913), a silent movie about a recording session, footage of Danny Keating jamming with lounge music legend Esquivel, and more.

DAY 3

Alexey Lukin (iZotope) offered a fascinating look into the history of noise reduction and current research in leveraging machine learning to map frequency and amplitude noise patterns and then build better noise reduction algorithms. "Data is the currency of machine learning," he said. Clean samples of noise can be stud-



The conference committee: from left, front row, John Krivit, Yuri Shimoda, Jessica Thompson, Mariana Mejía, and Nadja Walaszkovits; back row, Gregory Lukow (NAVCC Packard Campus Chief), George Massenburg, Brad McCoy, Toby Seay, David Ackerman, and Konrad Strauss.



The entire conference gathers for a group photograph.

LISTENING ROOMS

As if that weren't enough, throughout the conference, attendees had the option of slipping into the listening room to hear archival audio recordings in a concurrent session put together by the LOC's Curator of Recorded Sound Collections, Matt Barton. At any given time, attendees might hear classic field recordings or NBC radio broadcasts from the LOC's collection, rare Lou Reed recordings preserved by MARS's Steve Rosenthal, cylinders meticulously researched and restored by Meagan Hennessey and Rich Martin of Archeophone Records, musicologist, remastering engineer and producer Chris King sharing recordings collected while researching his latest book, *Lament From Epirus: Europe's Oldest Folk Music On Record*. This provided a welcome respite from the intensity of conference panels, and an opportunity to listen to the archival recordings attendees are devoted to preserving.

After three days, packed with information about the preservation of archival audio, conference attendees were grateful to convene on the grassy hillside at the Mountain Run Winery for a barbecue dinner and two complimentary glasses of local wine. (The Dog Rock rose was particularly refreshing.) Central Virginia's Mandorla provided music while attendees mingled and chatted, cementing friendships and partnerships and already looking forward to the next AES Archiving conference.

The conference planning committee is enormously grateful to our sponsors Iron Mountain, RIAA, NARAS P&E Wing, Izotope, Memnon, Cedar, NOA, ATC, Merging, Prism, Time-Step, ATR Magnetics, Cube-Tec, and MARS for their financial support. The team at the NAVCC: Rob Friedrich, Bob Norton, Bryan Hoffa, Brad McCoy, Patrick Smetanick, Brian Pinke, Rob Cristarella, Ryan Chroninger, and Chief of the NAVCC

ied and mapped, and that information can be analyzed to develop better tools for source separation and subtractive noise reduction beyond traditional multiband gate methods.

The Recording Academy Producers and Engineers wing (a sponsor of the conference) shared their Recommendations for Delivery of Recorded Music Products and their new Recommendations for high-resolution music production, "best practice" documents. P&E Wing Chair Maureen Dronney, Konrad Strauss, Michael Romanowski, and Chuck Ainley discussed the practicalities and challenges of archiving at the point of creation and the development of the DDEX metadata standard and RIN plug-in.

Closing remarks were given by Vienna Phonogrammarchiv's Dietrich Schüller, who's inspired talk reminded attendees why we devote our time, resources, and careers to the preservation of archival audio. Schüller spoke about the aims of UNESCO (the UN Agency for Education, Science, and Culture) in preserving the cultural and linguistic diversity of our world.

Packard Campus, Gregory Lukow. Special thanks to Matt Barton for curating the listening rooms, to Rob Friedrich for overseeing things, to Bil Haley, Paul Strum, and David March for making sure sound and video ran smoothly and sounded great in the theater. Finally, enormous thanks to John Krivit for chairing this conference, building a solid committee, and keeping us on track, well fed, and inspired. The consensus was overwhelming: we should do this again soon. As keynote speaker Bob Ludwig put it, "it was the most enjoyable AES function we have ever attended. A perfect combination of great people, great atmosphere, and we were incredibly well taken care of in the brownie and cupcake department. I hope we do it again."

Editor's note: AES Members can access the conference papers free of charge via the AES E-library at <http://www.aes.org/publications/conferences/>