The Restoration of Early Sound Recordings Using Optical Metrology and Image Analysis

Lawrence Berkeley National Laboratory and The Library of Congress

Historical recorded sound collections are at risk and are difficult to access.

Use optical surface profiling to create digital maps of the record surface, retouch image to repair damage, play with a virtual needle.

What is sound recording?

Phonautograph
Leon Scott
1853-60

Phonograph
Thomas Edison
1877

Scott **enscribed** sound on paper and could not reproduce it

Edison **embossed** sound on foil and was first to reproduce it.

T. A. EDISON.
Phonograph or Speaking Machine.
No. 200,521. Patented Feb. 19, 1878.

Mechanical properties of common records

Cylinder surface: vertical

ridge
~10 µm
127-254 µm
valley

Disc surface: lateral

~400 µm
150 µm

Mean depth: 64.924 µm | 65.258 µm | 65.487 µm | 65.601 µm | 65.186 µm

Inventors * Fieldwork * History * Studio

Sound recordings are at risk

mold
fungus

chemical
mechanical

breakage

Imaging Methods

Hi-res digital microphotography

3D: confocal microscopy

3D

2D

Polychromatic Point Source
Spectrometer
Spatial Filter
monochromatic image
Continuum of monochromatic images
Object Surface

Optical Scans: An inclusive data set

3D depth image: darker = deeper

Surface Damage
Hair
Raw data
Defects found by the cleaning algorithm are traced in orange
Hair and defects are smoothed by the cleaning algorithm
Filtered data
Profile along vertical line
Sudden change in height due to hair
Sudden change in height is smoothed out

Processed to emphasize structures and locate defects

Discos fonográficos Pathé
Caras y Caretas (7/7/1906)

Alexander Graham Bell Recordings

In1880 Bell establishes Volta Laboratory in Washington, D.C.,
to conduct signals research in association with
chemist Chichester Bell and instrument builder Charles S. Tainter.
Experimented with an astounding variety of materials and formats.
Artifacts and notes are in the Smithsonian Institution (>200 recordings).
12 Key recordings are optically scanned and exhibited in 2015:
"Hear My Voice: Alexander Graham Bell and the Origins of Recorded Sound"
http://americanhistory.si.edu/exhibitions/hear-my-voice

Univ. of California Language Survey

77 Native American languages are represented in the collection of ~3000 wax cylinders
>2700 have been optically scanned and restored to date

Yahi – Ishi 300 Recordings

"Wood Duck" Story

Pomo 31 Recordings

California Indians Root Languages
Penutian
Hokan
Uto-Aztecan
Athapascan
Yukian
Algonquian

Yurok 257 recordings

Central Sierra Miwok
145 Recordings

Oral Literature

~1930 aluminum an improved material for field recording

Shallow irregular embossed grooves, difficult to play

Harvard's Milman Parry Collection: 6000 recordings

Developing a robust and efficient optical process

Parry's analysis of oral song led to view that epic poems were orally transmitted.

Examples of important collections which are being studied using optical scanning methods.

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