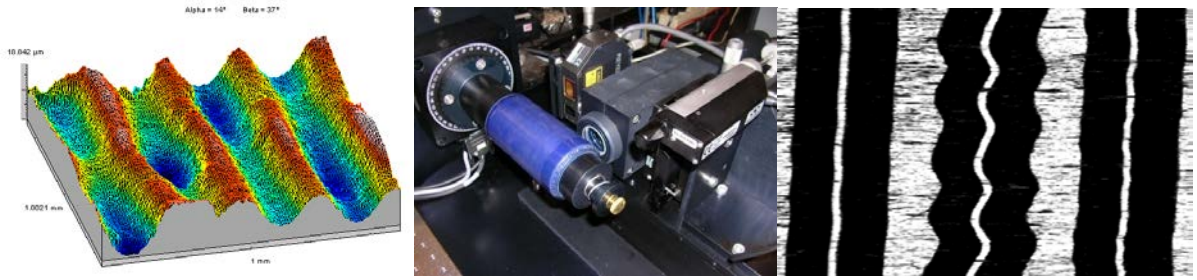
A significant challenge to the preservation and restoration of historically valuable sound recordings is finding methods to access the content safely and accurately. In recent years considerable progress has been made in the research and development of non-contact optical methods to restore, preserve, and create digital access to mechanical sound carriers. The basic idea is to create a digital representation (image) of the sound carrier surface and then extract the audio content by modeling the stylus motion on a computer. In 2004-2006, the "IRENE" project, funded by NEH, resulted in a system to scan disc records using digital microphotography in two dimensions. In 2007-2012, the "3D/PRISM" and later projects, funded mainly by IMLS, focused on the extension of the IRENE approach to three dimensional imaging of cylinders and discs using confocal microscopy. (See figure below, of a scanner, and images). These systems output standard audio, image and data file formats supported by libraries and archives.

In recent years, the research project has addressed a variety of collaborative studies needed to advance this technology further, build sustainability into its design, and make it available and relevant to collections of diverse character and location, nationally and internationally. The technology is developed at Lawrence Berkeley National Laboratory, in Berkeley, California (URL http://irene.lbl.gov/, contact: chhaber@lbl.gov). The Library of Congress has been a long term partner and has guided many aspects of the development. Additional partners have been The Phoebe Hearst Museum of Anthropology, The University of Chicago South Asia Library, The Berlin Phonogramm Archive, The Smithsonian Institution, the Edison National Historic Site, and the University of Applied Science, Fribourg, Switzerland.



The project addresses the needs of libraries, museums, and archives, holding collections of mechanical (grooved) sound carriers and their stakeholders. The non-contact playback and analysis technology applied is relevant to carriers in legacy formats which may be at risk for damage and degradation. Collections of scale which require mass digitization stand to benefit from the automation of data collection and analysis strategies employed by here. Aspects of the research include,

- Archive workflow: A 2D scanning system has been installed at the Library of Congress and the National Audio Visual Conservation Center, Culpeper, Va., for evaluation as a production tool.
- Remote operations: A "portable" 2D system has been built for the Univ. of Chicago and installed at the Roja Muthiah Library, Chennai, India, for use with early 20th century record collections.
- A 3D digitization pilot study of wax ethnographic fieldwork cylinders has been completed.
- Audio extracted from diverse formats: shellac, acetate, wax, aluminum, cellulose, Berliner discs.
- A copper "galvano" cylinder mold from the Berlin Phonogramm Archive has been digitized.
- Many early experimental recordings from the mid-to-late 19th century have been restored.
- Tools for the virtual reassembly of broken carriers have been created, including a complete measurement of the Dickson Cylinder, Thomas Edison's 1893 attempt to synchronize film and audio.

From the left (a) Depth image from wax cylinder showing damage from fibers on the surface (~1910). (b) Experimental recording, wax on paper, Smithsonian (A.G. Bell, early 1880's) (c) Copper cylinder "galvano" mold (early 20th century). (d) The Dickson Cylinder from Edison National Historic Site (1893).