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## Back to the Tape: Developing tools for the recovery of historical audio recordings

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Audio storage has evolved significantly, from analog phonographs to digital formats like CDs and audio files. Among these, magnetic tape has played a pivotal role, offering high-fidelity sound, rewritability, and adaptability for both personal and professional use. Magnetic tape recordings form a substantial part of the world's cultural heritage, preserving iconic music and valuable historical archives. However, over time, wear and chemical degradation threaten these recordings, rendering them unreadable with traditional playback methods and risking irreversible damage to culturally significant content.

To address this, a collaboration between INESC-MN and the Paul Scherrer Institute (PSI) aims to develop non-destructive, contactless techniques for audio restoration. INESC-MN utilizes tunneling magnetoresistance (TMR) sensors to detect weak magnetic fields without causing physical wear, while PSI employs high-resolution X-ray beams to read magnetic particle states. Despite their promise, these methods introduce noise and distortion, requiring advanced signal processing to ensure faithful recovery.

This project focuses on three primary goals: restoring raw signals by reducing noise and distortion, reconstructing audio signals to replicate the tonal characteristics of original recordings, and enhancing measurement efficiency through adaptive sampling algorithms. Ultimately, the project seeks to recover degraded recordings, such as a 1980 B.B. King performance at the Montreux Jazz Festival, contributing to the preservation of audio heritage and preventing the loss of irreplaceable cultural artifacts.

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