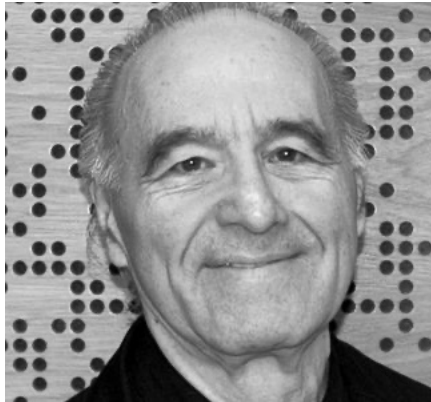# REDIAcoustics' New Scientific Approach for Acoustical Analysis of Small Critical Listening Environments

NIRO™ (Non-cuboid Iterative Room Optimization)

A Full Spectrum Predictive / Iterative Acoustic Analysis Software Tool

Founding Partners

| Dr. Peter D'Antonio | John Storyk | PK Pandey |

The long-standing impediment to accurately predicting the acoustic qualities of small critical listening environments (e.g. pro audio control rooms, broadcast production suites, home theaters and corporate conference rooms) has been resolved by NIRO™. Created by acoustic R&D firm REDIacoustics, NIRO is a groundbreaking wave-based, computer-modeling software tool. REDIacoustics is now offering a gold standard consulting service using this research. NIRO facilitates the predictive, iterative acoustic analysis required to optimize the acoustic qualities of compact studio control rooms, home theaters, and audiophile listening rooms, and is particularly accurate at low frequency analysis (specifically below Schroeder frequencies).

1. What is the Challenge?

The central problem impacting sound *production* rooms, such as recording control rooms and film mix studios, is removing "acoustic coloration." Undesirable coloration is caused by the room's modal response, speaker boundary interference, low frequency temporal decay and intrusion by early reflections at mid and high frequencies. When these issues are identified and the REDIacoustics solution is implemented, the created musical mix is transferable to a wide range of sound *reproduction* environments, including home theaters, cars and headphones. What is required is a "neutral room," making it possible to **"Listen to the music, *not the Room!*"**

2. Who formed REDIacoustics and who's on the team?

In 2019 **Peter D'Antonio** a pioneering sound diffusion expert and founder of RPG Diffusor Systems, Inc. joined with **John Storyk,** founding partner of WSDG, a global architectural acoustic consulting and design firm and **PK Pandey,** founder of Guitar Center's GCPro B2B division, Symphonic Acoustics & Boston's Mad Oak Studios, to establish an elite team of acoustic engineers and software programmers to form REDIacoustics. The firm devoted over two years of intensive research and development to create a "**N**on-**c**uboid **I**terative **R**oom **O**ptimizer" (NIRO) to

resolve acoustic issues obstructing the ability to decipher and correct the design elements that were impeding architects and acoustician's ability to achieve the elusive "sweet spot" of critical listening environments, regardless of irregular room shape and dimensions. Completing the research team are Rinaldi Petrolli, Thiago Sanchez and Artur Zorzo (learn more at [REDIacoustics)]().

3. What is the scientific methodology required

To address the modal resonances and speaker boundary interference at low frequency, a wave acoustics solution such as the Boundary Element Method (BEM) must be engaged. At mid and high frequencies, geometrical acoustics can be employed to control interfering reflections.

The REDI team developed NIRO as a comprehensive, full spectrum, design and diagnostic program to:

a. Provide an iterative **Geometry Module** that relies on BEM to predict the room's modal response and, an iterative genetic algorithm to simultaneously determine the optimal room geometry, including positions of speakers and listeners.

b. Employ the **Damper Module** to minimize the influence of interfering specular reflections and further minimize modal emphasis and temporal ringing, using new **A**coustical **P**arametric **EQ**ualizer (APEQ) modules, which are fine-tuned acoustic treatments specific to each problematic frequency. Their complex surface impedances are calculated, using the Transfer Matrix Method, and validated by impedance tube measurements.

c. Finally, NIRO features a geometric acoustics **Reflection Module** to identify interfering reflections at the listening positions

4. A practical overview by REDIacoustics' founding partners

Peter D'Antonio:
The NIRO process starts with obtaining an understanding of the room's intended use and architectural constraints, including accessible ranges for the room's dimensions and shape, speaker and listener positions and available locations for acoustical treatment. A 3D drawing is created, and the room's surface is discretized, as shown in the figure, for analysis.
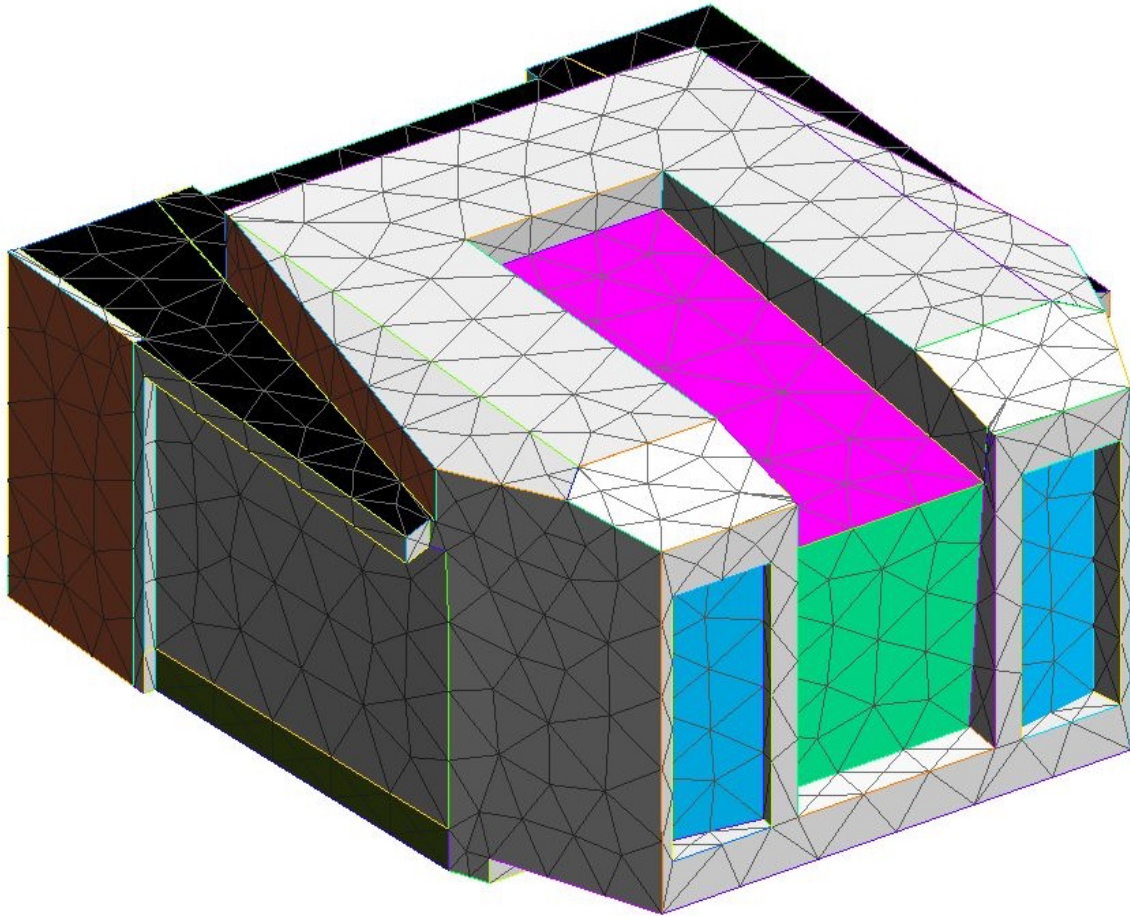
This Geometric Optimization is the first phase of NIRO. The *complete results of the analysis are incorporated into a report listing suggested dimensional changes, if possible, locations for all speakers and listeners and the critical (low frequency) APEQ(s) design characteristics and placement.*

John Storyk:
NIRO identifies optimized geometry and specific frequency-dependent damper (APEQ) locations. We rarely rely on large broadband bass traps (velocity absorbers), because today's relatively small studios and production environments require custom-designed **thin** *low-frequency control panels. Client preference (and budget) generally dictate treatment decisions. We are aligned with a short list of certified manufacturers, capable of fabricating these treatments to NIRO tested certifications. The recommended NIRO-designed APEQs (pressure absorbers) are typically located at specific fixed positions - attached directly to the walls and ceilings to accommodate architectural, ergonomic and aesthetic requirements (shown here is a typical* NIRO™ report*). NIRO's implementation at the earliest design moment can be critical in developing optimal acoustic conditions prior to construction. By previewing the sound of a room before it is built, we can accurately illustrate how various treatments and/or specific architectural design modifications can perfect the acoustic behavior of the environment.*

5. Who can benefit from the NIRO service?

The NIRO predictive design service will benefit all users associated with high end listening environments, including musicians, audio engineers, audiophiles and home theaters owners. The program can be seamlessly integrated into the complete design package of audio system dealers, system integrators, loudspeaker manufacturers, acousticians and architects. The SaaS (software as a service) creates a comprehensive analysis and recommendations report that enables experienced acousticians or designers to expand NIRO's findings into a fully developed set of

construction documents *or simultaneously* inform a DIY approach for clients capable of tackling the fabrication of custom damping modules (APEQ'S).

6. Projects, Clients & Successful Applications

The NIRO program has been successfully utilized in nearly 80 projects during the past two years, several already completed and installed. An early example of NIRO's benefits is illustrated by its impact on the renovation of the Abbott Road Studio in Boston.

Owned by Rob Jaczko, a Platinum and Gold Record RIAA certified engineer whose credits include Warren Zevon, Don Henley, Bruce Springsteen, Sheryl Crow and James Taylor. Jaczko is also Chairman of the Music Production & Engineering Department at Berklee College of Music in Boston, MA.

NIRO analysis has been used successfully for critical listening environment design on recent projects for Spotify - LA; Sony - LA: University of Hartford: Mix with the Masters (Paris;) Tony Carreira Studios(Portugal;) Ex Machina(Brooklyn, NY;) and more.

In summary, NIRO addresses the 3A's, **A**rchitecture, **A**coustics and **A**udio

NIRO's predictive analysis platform respects the **Architecture** and any imposed constraints of the listening environment. The treatment solution package creates **Acoustic** solutions that minimizes coloration and provides a neutral listening condition. (*Listen to the music not the Room*). The end user and his/her team can and should "fine tune" their **Audio** system to suit personal taste and musical genre.