AQUA-RIUS: Audio QUality Analysis for Representing, Indexing and Unifying Signals

Analyse de la QUalité Audio pour Représenter, Indexer et Unifier les Signaux

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Audio Quality (AQ) Scientific Problem

What is audio quality ?

As instrumental sound "timbre" is defined as all sound characteristics not related to pitch, loudness and duration, "audio quality" is everything related to the sound characteristics not related to the content sources. (ie. recording media, lossy compression, mastering, etc.)

Motivation :

- Detecting AQ is full of interest for audio indexing systems (AQ is related to listening experience)
- AQ can have an impact on the prediction accuracy of music information retrieval systems
- AQ results from recording conditions and studio practices
- Controlling AQ can enable robust machine learning methods (ie. data augmentation, models invariant to unwanted signal transformations)

Research Context and Challenges

ABC-DJ H2020 Project (688122) : 2016-2018, ≈ 3.5 M€

Artist-to-Business / Business-to-Consumer Audio Branding Systems (`https://abcdj.eu/`)

- Automatic indexing of large music database through Music Information Retrieval
- Removal of duplicate and spurious entries (keeping the version with the best audio quality)
- Music recommendation and automatic playlist generation
- Music summary generation [Peeters et al., 2002]
- Automatic DJ-mixing and -unmixing [Schwarz, Fourer, 2021]
- etc.

Challenges

- AQ has not yet been accurately characterized : only empirical features about the signal processing chain
- AQ requires an exhaustive investigation of the related audio effects : analysis / cancellation / inversion
- AQ is related to inverse problems : audio reverse-engineering / audio source separation / unmixing / etc.

The AQUA-RIUS project - ANR-22-CE23-0022

- from **jan. 2023** to **june 2026**
- 510 157.90 €
- 3 labs : IBISC (Univ. Evry) / UMR STMS (IRCAM) / LTCI (TelecomParis)

Goals

- Exhaustive investigation of "audio quality" : analysis/modeling with a focus to prediction/detection of the audio effects applied during the audio signal production and diffusion chain
- Simulation and synthesis of audio quality with possible applications to data augmentation and domain adaptation techniques using machine-learning-based methods
- Audio Quality control with application to audio effects canceling/reverting and signal enhancement/restoration

Project members

IBISC	Name	Position	Months	Expertise relevant to the project
Coordinator	**D. Fourer**	MCF	21 (50 %)	audio, time-frequency, reassignment, deep learning
Member	H. Maaref	PR	14 (33 %)	optimization, machine learning, signal processing
Total		2	**35**	

Télécom-Paris	Name	Position	Months	Expertise relevant to the project
Coordinator	**G. Peeters**	PR	21 (50 %)	audio, MIR, deep learning
Total		1	**21**	

IRCAM	Name	Position	Months	Expertise relevant to the project
Coordinator	**R. Mignot**	CR	11 (25 %)	audio, MIR, machine learning
Member	D. Schwarz	CR	7 (16.8 %)	audio, MIR, DJ and studio mix, artistic applications
Total		2	**18**	

Supported by ANR

- two 3-year PhD (IBISC / Télécom Paris)
- one 18-month post-doc (IRCAM)
- several 6-month research internships

Project Organization

WP0 : Project Management (Leader : IBISC)

WP1 : Audio dataset recording/collection/generation (Leader : IRCAM)

- T1.1 : Dataset Recording/Collection and Generation
- T1.2 : AQ Direct Simulation Toolbox
- T1.3 : Public Distribution and Reproducibility

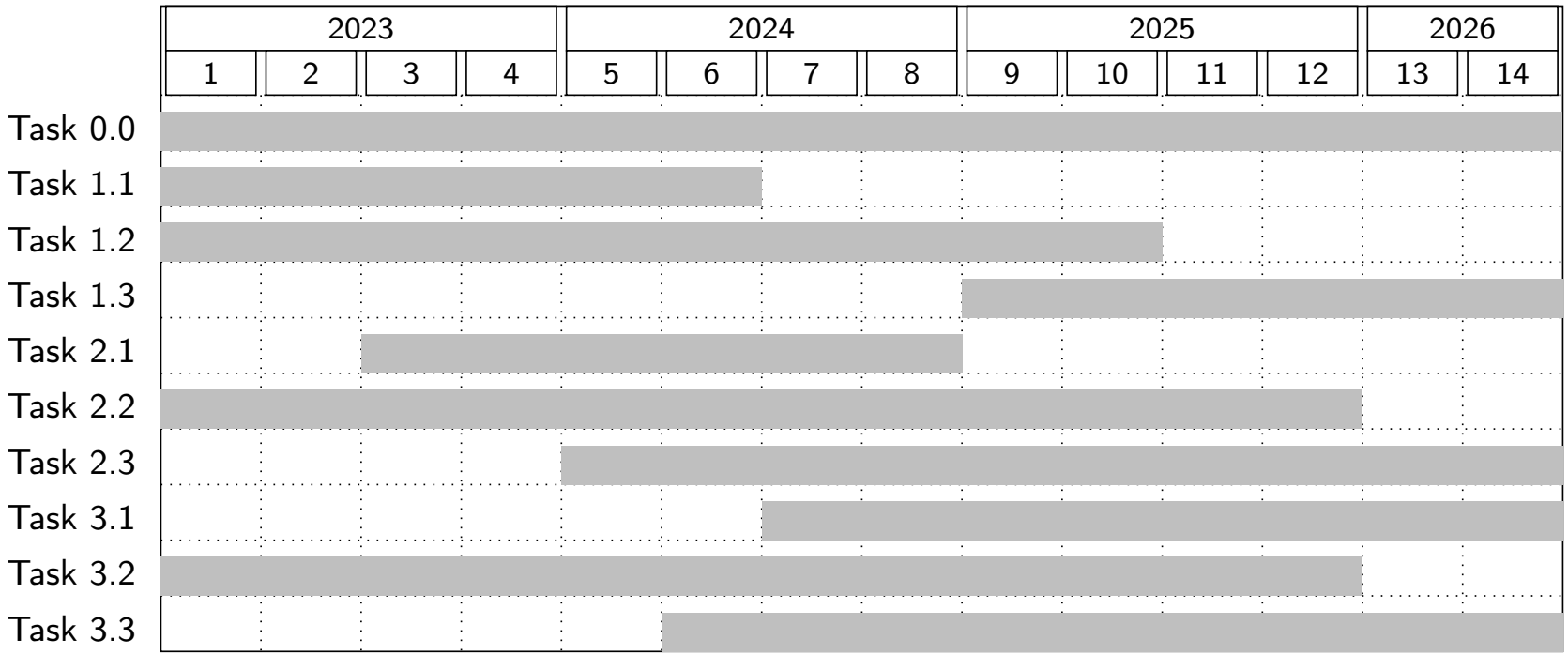
WP2 : AQ Analysis and Description (Leader : LTCI)

- T2.1 : Artifact/Degradation Detection
- T2.2 : Effects chain estimation
- T2.3 : AQ description

WP3 : AQ Simulation and Inversion (Leader : IBISC)

- T3.1 : Data Augmentation
- T3.2 : Generative Models for Simulation and Inversion
- T3.3 : Signal Restoration, Music Unmixing and Re-mixing

Gantt chart



Supported by ANR

- IRCAM postdoc on T1.2 (AQ direct simulation toolbox)
- LTCI PhD on T2.2 (effects chain estimation)
- IBISC PhD on T3.2 (generative models for AQ simulation and inversion)