



une solution ouverte d'archivage pérenne pour les données musicales de la recherche

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GIS SPADON - 23 septembre 2014 - LAM, Paris

Introduction

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- 2 The Telemeta platform
- 3 TimeSide, an audio analysis framework
- 4 Sound archives of the CNRS - Musée de l'Homme
- 5 The DIADEMS project
- 6 Archivage pérenne
- 7 Conclusion

Introduction

Context

- Since 2007, the Research Center for Ethnomusicology (CREM) and Parisson have been developing an innovative, collaborative and open-source **web-based multimedia platform** for **humanities and social sciences research**.
- Official platform online since 2010 :
Sound archives of the CNRS - Musée de l'Homme
<http://archives.crem-cnrs.fr>
- This **collaborative** platform support numerous aspects of the field of **ethnomusicology**, ranging from musical analysis to comparative history and the anthropology of music. The platform also provides many useful resources for the fields of anthropology, linguistics and acoustics.

Introduction

Towards automatic audio content analysis ...

- Recently, an open-source **audio analysis framework**, TimeSide, has been developed to bring automatic audio content analysis capabilities to the Telemeta web platform.

... and interdisciplinary collaboration

- Since 2013, as part of the DIADEMS project, academic researchers and engineers from the *Science and Technology of Information and Communication* domain and researchers from the *Musicology and Ethnomusicology* domain have been collaborating to develop new computer tools to **automatically index** the recording contents.

The Telemeta platform

1 Introduction

2 The Telemeta platform

- Features
- Metadata
- Architecture

3 TimeSide, an audio analysis framework

4 Sound archives of the CNRS - Musée de l'Homme

5 The DIADEMS project

The Telemeta platform

A scalable web audio platform

- access, preserve and share sound items
- enrich associated metadata that contains key information on the context and significance of the recording.

An open-source software

- Telemeta, is a free and open source software (*GPL-like* licence) in accordance with open web standards.



<http://telemeta.org/>

Telemeta Item page

CREM
Centre de Recherche
en Ethnomusicologie

Search | Search

Welcome, Thomas Filion | Profile | Help | Sign out

Desk Archives Geo Navigator Advanced search Users Admin

Item : Bruits iconiques de lamentation :

Edit Copy Add to playlist Previous Next

Spectrogram Lin

00:00 00:34 01:00 01:30 02:00 02:30 03:00 03:30 04:00 04:30 05:00 05:30 06:00 06:30 07:00 07:30 08:00 08:30

1 2 3 4 5 6 7 8 9 10 11

Nasalisation et octavation

Title: Bruits iconiques de lamentation :
Original title / translation: Déploration de la bataille de Kerbala
Collector: LAMBERT, JEAN
Collection: CNRSMH_I_2013_611
Recording date: Jan. 1, 1998 - Dec. 31, 1998
Last modification: April 8, 2014, 10:50 p.m. (j.lambert)

Analysis Markers

00:00:07.87 Chute dans le grave à la ! EDIT
author: j.lambert

00:00:29.63 Chute dans le grave EDIT
author: j.lambert

00:00:34.81 Chute dans le grave EDIT

Geographic and cultural informations
Musical informations
Archiving data

Web audio content management features and architecture

Main features of Telemeta

- Pure **HTML5** web user interface including dynamic forms.
- Database management through a Structured Query Language (**SQL**) or Oracle backend.
- **On-the-fly audio analyzing**, transcoding and metadata embedding in various multimedia formats, provided through an external component, *TimeSide*.
- Social editing with semantic ontologies, smart workflows, human or automatic annotations and segmentations.
- **User management** with individual desk, playlists, profiles and group access rights.
- High level **search engine** geolocation, instruments, ethnic groups, etc...).
- Multi-language support (currently english, german, french and chinese).

Metadata

In addition to the audio data, an efficient and dynamic management of the associated metadata is also offered.

- Metadata provides valuable informations about the **source of the data** and to the related **work of peer researchers**.
- Dynamically handling metadata in a **collaborative** manner optimizes the continuous process of knowledge gathering and the **enrichment** of the materials in the database.
- One of the major challenges is the **standardization** of audio and metadata formats with the aim of long-term preservation and usage of the different materials.
- The compatibility with other systems is facilitated by the integration of the **metadata standards protocols** *Dublin Core* and *OAI-PMH* (Open Archives Initiative Protocol for Metadata Harvesting).

Metadata

Contextual Information

Contextual Information

In an ethnomusicological framework, contextual information may include:

- Geographic information
- Cultural information (population, related cultural elements, ...)
- Musical information (title, instruments, ...)
- Archive or recording information (recording technical data, depositor, collector, year of the recording, year of publication of papers describing the work, ...)

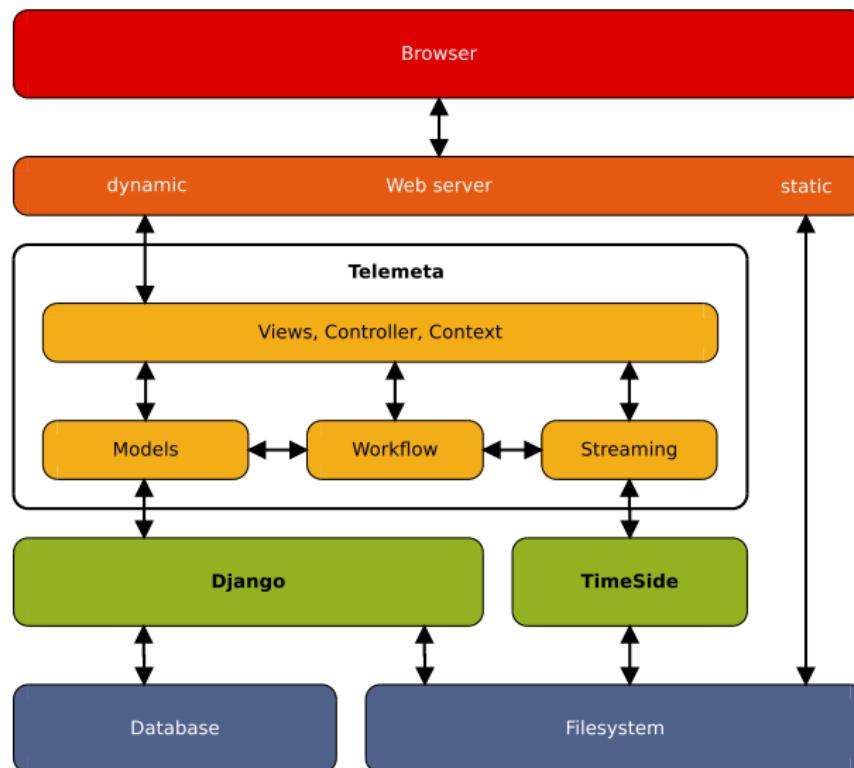
Additional materials

Moreover, through the platform, diverse materials related to the archives can be stored, such as:

- iconographies (digitalized pictures, scans of booklets and field notes, and so on),
- hyperlinks and
- biographical information about the collector.

Examples

Telemeta architecture



Descriptive and analytical information

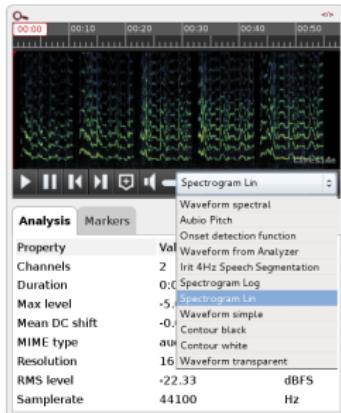
Visual representation and segmentation

Visual representation of the sound

The embedded **TimeSide** audio player allows for a selection of various visual representations of the sound (e.g. **waveforms and spectrograms**) and some representations of computational **analysis**.

Segmentation

Automatic analysis can produce a list of **time-segments** associated with **labels** (e.g. detection of spoken versus singing voices, chorus, musical instrument categories, and so on).

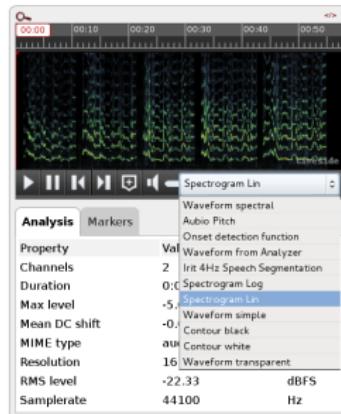


Descriptive and analytical information

Visual representation and segmentation

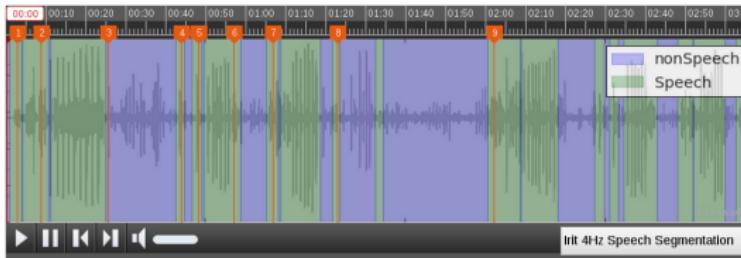
Visual representation of the sound

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Segmentation

Automatic analysis can produce a list of **time-segments** associated with **labels** (e.g. detection of spoken versus singing voices, chorus, musical instrument categories, and so on).



Descriptive and analytical information on the audio content

Annotations

Markers

- The embedded audio player also enables annotation of the audio content through **time-coded markers**.
- These annotations are **indexed** through the database.
- Users can create their own annotations and **share** them with colleagues.



TimeSide, an audio analysis framework

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 - Audio features extraction
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TimeSide

An open web audio processing framework

- TimeSide is the **signal processing engine** of Telemeta developed and published as a separate project.
- TimeSide is an **open-source audio analysis and visualization framework** based on both **Python** and **JavaScript** languages that provides state-of-the-art signal processing and machine learning algorithms together with **web audio** capabilities for displaying and streaming files.

<https://github.com/yomguy/TimeSide/>

Audio management

TimeSide provides the following main features:

- Smart dynamic audio player with enhanced visualization (e.g. waveform, spectrogram) that can be embedded into any html page through *iframe* (live example: [Yomguy's blog](#))
- Multi-format support: decodes the vast majority of audio and video formats
- On-the-fly audio analysis, transcoding, streaming and metadata embedding based on an easy plugin architecture.

Audio features extraction

Audio features extraction

TimeSide incorporates some state-of-the-art **audio feature extraction libraries** such as:

- Aubio: <http://aubio.org>
- Yaafe: <http://yaafe.sourceforge.net>
- Vamp plugins: <http://www.vamp-plugins.org>

Given the extracted features, every sound item in a given collection can be automatically analyzed.

The results of this analysis can be:

- Serialized to the web browser through common markup languages: XML, JSON and YAML
- Stored in a scientific file format (e.g. NumPy format or HDF5)
- Exported to sound visualization and annotation software (e.g. Sonic Visualizer)

TimeSide engine architecture

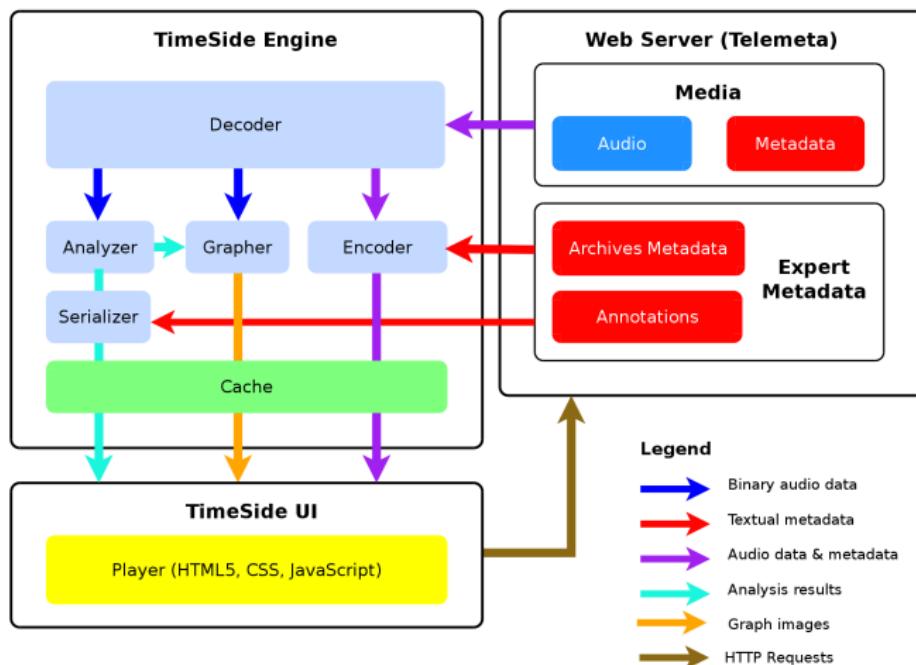
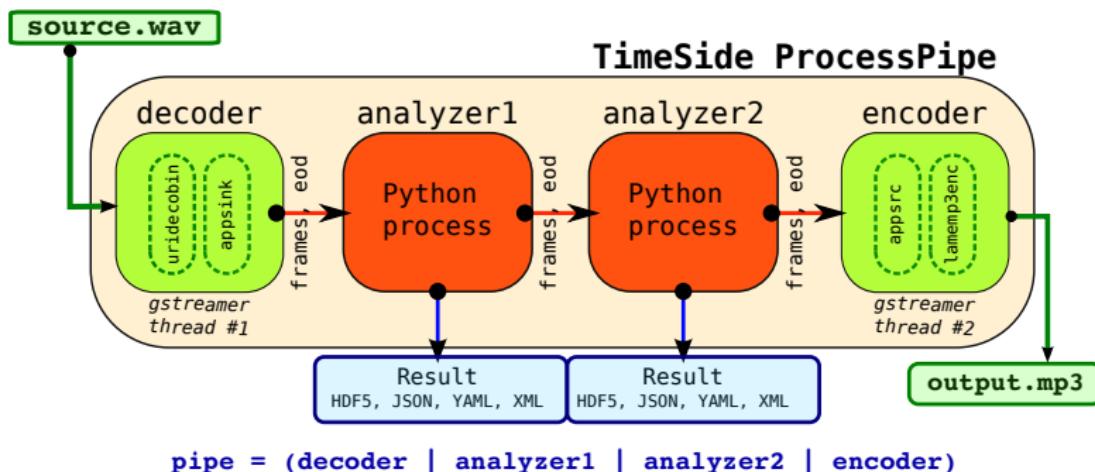


Figure: TimeSide engine architecture and data flow with Telemeta web-server

TimeSide engine architecture



Process Pipe

- On-the-fly audio processing by simultaneous processors (decoder, encoders, analyzers, graphers)
- Use of *Gstreamer* for audio decoding and encoding

Sound archives of the CNRS - Musée de l'Homme

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- Archiving research materials
- Uses and users of digital sound archives

5 The DIADEMS project

Sound archives of the CNRS - Musée de l'Homme

- Since June 2011, the Telemeta platform has been used by the **Sound archives of the CNRS - Musée de l'Homme^a** and managed by the CREM.
- These archives available for researchers, students and (when copyright allows) to a broader audience.
- It is one of the most important Sound archives library in Europe
- Through this platform, these archives can be shared, discussed and analyzed.

^a<http://archives.crem-cnrs.fr>

Archiving research materials

- The Sound archives of the *CNRS - Musée de l'Homme* have been collected by researchers attached to numerous research institutions across the world.
- Most of the recordings come from the fieldwork of researchers in **all continents** during the last **110 years**.
- Nearly **3700 hours of record collections** e.g. more than 5000 discs, many of which are very rare)
- **4000 hours of unpublished recordings**, from early research expeditions (e.g. Dakar-Djibouti (1932), Ogooué-Congo (1946)).
- **47,200 items** containing more than **26,000 sound files** (including 12,000 sounds on free access since May 2014).

Uses and users of digital sound archives

- Three main activities: **archiving, research and education**
- Three main disciplines: **Ethnomusicology, Anthropology and Linguistic**
- Primary users of the platform are archivists, researchers, students and professors of these disciplines.
- Nonetheless, a qualitative survey showed that other disciplines (such as Art History) have used the platform.
- When used for education, the platform provides a wide array of teaching materials to illustrate the work of students as well as support teaching curricula.

Uses and users of digital sound archives

A collaborative experience

- The sharing of data offer resources to researchers from all over the world and allows several people to **collaborate on the enrichment of the database**.
- Researchers from different institutions can work together on specific audio materials and conduct individual research from both synchronic and diachronic perspectives on their own material, the material of others, or both.
- Users can submit their own archives to protect them.
- Furthermore, it facilitates the ethical task of **returning the recorded music to the communities who produced it** and to get local populations involved in their own cultural heritage.

The DIADEMS project

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 - Consortium and goals
 - The method of a new interdisciplinary research
 - Evaluation and future improvements

The DIADEMS project

Started in January 2013, the French national research program DIADEMS is a multi-disciplinary project dedicated to the **Description, Indexation, Access to Ethnomusicological and Sound Documents**.

The consortium

Science and Technology of Information and Communication domain



Institute of research in computing science of Toulouse
Laboratory of computing and mechanics for engineering sciences

Bordeaux Computer Science Research Laboratory

Laboratory of Musical Acoustic, Jean Le Rond d'Alembert Institute

Musicology and Ethnomusicology domain



Laboratory of Ethnology and Comparative Sociology

Research Center for Ethnomusicology

National Museum of Natural History

Development



Parisson, the company involved in the development of Telemeta.

Goals of the DIADEMS project

Goals and on-going development

- The goal of the DIADEMS project is to develop computer tools to **automatically index** or assist the indexation of the recording content from the audio signal.
- Ongoing work consists of implementing advanced **classification, indexation, segmentation and similarity analysis** methods.
- **Besides music analysis**, such automatic tools also deal with speech and other types of sounds present ethnomusicological recordings like **speech, environmental noises and noises generated by the recording process**

The method of a new interdisciplinary research

- In this research program, groups from **different backgrounds** are working together.
- The first challenge was to initiate a common interest and a **mutual understanding**.
- In this process, DIADEMS gave us the opportunity to improve our understanding on the **link between the semantics and acoustics of voice production** in order to be able to specify the classification and indexation tasks.

Evaluation and Future improvements

Development and Evaluations

- Interesting preliminary results have been obtained regarding the detection of start times of recording sessions, speech recognition, singing voice recognition and musical instrument family classification.
- The robustness of these processings is assessed using **criteria defined by the final users**: teachers, students, researchers and musicians.
- **After validation**, Analysis and Annotation tools, as well as the provided annotations, will be integrated in the Telemeta platform.

Archivage pérenne

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- 6 Archivage pérenne
 - Stratégie
 - Standards et outils
 - Supports physiques

Stratégie

Problématiques

- comment archiver des données évolutives ?
- comment sauvegarder l'information audio et les metadonnées
- comment sauvegarder le système qui les lit/lie ?
- quels supports physiques choisir ?
- quel protocole ?
- quelle architecture ?
- comment éviter la sur-consommation des fermes de serveurs ?

Stratégie

Solutions

- OS libres et systèmes de fichiers ouverts
- formats de données standards et normalisés
- environnements logiciels virtualisés
- versionnement des logiciels et des données
- migrations des modèles de données (MVC)
- moissonnage des données au fil de l'eau (OAI-PMH, API)
- architecture distribuée et sécurisée
- synchronisation hebdomadaire des OS, bases de données ET logiciels sur fermes de serveurs (IN2P3 / CINES)
- synchronisation mensuelle sur NAS dédiés et "réveillés" uniquement pour la sauvegarde

Standards et outils

Langages, technologies et formats ouverts

- WAV, FLAC, OGG, Opus
- HTML, CSS, JavaScript, JSON, RDF
- Django, TimeSide
- Python, C, C++
- MySQL, PostgreSQL, MongoDB
- Ext4, Btrfs
- GNU, Linux, Docker, Git

Backup / synchro

- Django (manage.py backup)
- Rsync + SSH
- IRODS

Supports physiques

Etude IBM 2012

- Tape
- HDD
- NAND

[PDF link](#)

Cas d'usage

- Edition (temps réel) : NAND + HDD
- Sauvegarde (moyen terme) : HDD (+ NAS)
- Conservation (long terme) : Tape

Conclusion

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Conclusion

- Telemeta is a **fully operational** web audio framework for managing digital sound archives
- It's an **open-source** software (-> feel free to use, fork or contribute)
- Through the Sound archives of the CNRS - Musée de l'Homme, it is now used by many ethnomusicologists around the world for research or education purposes.
- Its collaborative nature enable a **continuous enrichment** of the audio content, the metadata and the analysis tools.

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Conclusion

Future developments

Future developments will turn Telemeta into:

- an efficient **annotation platform** (with zoom and segment selection)
- an **social and collaborative platform** (user access management and social stuff)
- an **interdisciplinary** collaborative platform between IT and ethno with the joint development of automatic analysis and indexation tools

Regarding TimeSide, a Web-API is being developed to provide audio analysis services over the web.

Thank You !

- Contact: guillaume.pellerin@parisson.com
- Telemeta:



- TimeSide:

<https://github.com/yomguy/TimeSide/>

- Sound archives of the CNRS - Musée de l'Homme:

<http://archives.crem-cnrs.fr>

- The DIADEMS project:

<http://www.irit.fr/recherches/SAMOVA/DIADEMS/>

Additional Materials

8 Additional Materials

- Telemeta - Geographic Navigator
- Multi language support
- Metadata

Telemeta - Geographic Navigator

Desk Archives **Geo Navigator** Advanced search Users

 Geographic Navigator Map | List


Map | Satellite



The map displays a global distribution of data points, with concentrations in Europe, Africa, and South America. Labels for specific countries and regions are visible, such as Canada, United States, Mexico, Venezuela, Colombia, Peru, Brazil, Bolivia, Argentina, Chile, Iceland, Norway, Sweden, Denmark, France, Spain, Italy, Portugal, Greece, Turkey, Russia, Mongolia, China, South Korea, Japan, India, Pakistan, Thailand, Vietnam, Laos, Cambodia, Myanmar, Malaysia, Singapore, Indonesia, Australia, and New Zealand.

North Pacific Ocean North Atlantic Ocean South Pacific Ocean South Atlantic Ocean Indian Ocean

Google Terms of Use | Report a map error

back

Telemeta - Multi language support

English



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Search

Welcome, Thomas Filion | Profile | Help | Sign out

[Desk](#) [Archives](#) [Geo Navigator](#) [Advanced search](#) [Users](#)

 Item : TROMPE ET TAMBOUR :41-15

Edit Copy Add to playlist Previous Next

Title: TROMPE ET TAMBOUR

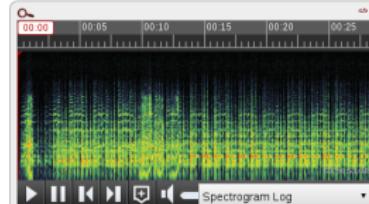
Original title / translation: OLU BOY

Collector:

Collection: CNRSMH_I_1970_012

Recording date: Nov. 1, 1960 - Nov. 30, 1960

Last modification: Oct. 24, 2012, 5:39 p.m. (admin)



Spectrogram Log

 Geographic and cultural informations

Location	Mali, Afrique occidentale, Afrique
Location details	SANGA
Population / social group	DOGON
Ethnographic context	

 Musical informations

Number	Composition	Vernacular name	Interprets
1	Trompe	KAKELE	
1	Tambour frappé	BOYDUNULE	

 Archiving data

Code	CNRSMH_I_1970_012_041_15
Original code	BM.1970.012.001/46:41-15
... more	

« » ◀ ▶ ◀◀ ▶▶ ◀◀◀ ▶▶▶ ◀◀◀◀ ▶▶▶▶ ☰ 🔍

Telemeta - Multi language support

French

 Centre de Recherche en Ethnomusicologie

Recherche Recherche

Bienvenue, Thomas Fillion | Profil | Aide | Déconnexion

Bureau Archives Géo-Navigateur Recherche avancée Utilisateurs

Item : TROMPE ET TAMBOUR :41-15

Titre	TROMPE ET TAMBOUR
Titre original / traduction	OLU BOY
Collecteur	
Collection	CNRSMH_I_1970_012
Date d'enregistrement	1 novembre 1960 - 30 novembre 1960
Dernière modification	24 octobre 2012 17:39:17 (admin)

Indications géographiques et culturelles

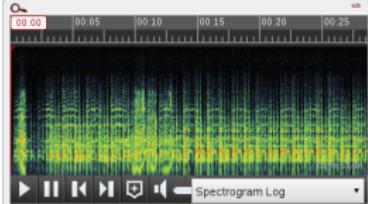
Lieu	Mali, Afrique occidentale, Afrique
Precisions lieu	SANGA
Population / groupe social	DOGON
Contexte ethnographique	

Informations sur la musique

Nombre	Voix / Instruments	Nom vernaculaire	Interprètes
1	Trompe	KAKELE	
1	Tambour frappé	BOYDUNULE	

Données d'archivage

Cote	CNRSMH_I_1970_012_041_15
Cote originale	BM.1970.012.001/46:41-15



Analyse Marqueurs

Propriété	Valeur	Unité
Channels	1	
Duration	0:00:28.73	s
Max level	-3.816	dBFS
Mean DC shift	-0	%
MIME type	audio/x-wav	
Resolution	24	bits
RMS level	-19.12	dBFS
Samplerate	48000	Hz

Telemeta - Multi language support

German



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en Ethnomusicologie

Suche

[Arbeitsfläche](#) [Archive](#) [Kartennavigation](#) [erweiterte Suche](#) [BenutzerInnen](#)

 Item : TROMPE ET TAMBOUR :41-15

 bearbeiten
 kopieren

 zu Wiedergabeliste hinzufügen
 vorhergehend
 nächste

Titel	TROMPE ET TAMBOUR
Originaltitel / Übersetzung	OLU BOY
Sammlerin	
Sammlung	CNRSMH_I_1970_012
Aufnahmedatum	1. November 1960 - 30. November 1960
Letzte Änderung	24. Oktober 2012 17:39:17 (admin)

 geographische und kulturelle Informationen

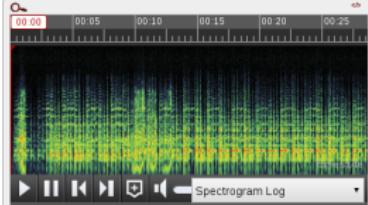
Aufnahmeort	Mali, Afrique occidentale, Afrique
Einzelheiten zum Ort	SANGA
Bevölkerung / soziale Gruppe	DOGON
Ethnographic context	

 Musical informations

Nummer	Komposition	Umgangssprachlicher Name	InterpretInnen
1	Trompe	KAKELE	
1	Tambour frappé	BOYDUNULE	

 Archivdaten

Code	CNRSMH_I_1970_012_041_15
------	--------------------------



Analyse Marken

Eigenschaft	Wert	Einheit
Channels	1	s
Duration	0:00:28.73	
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Telemeta - Multi language support

Chinese

CREM
Centre de Recherche en Ethnomusicologie

搜索 搜索

欢迎, Thomas Fillion | 资料 | 帮助 | 注销

桌面 档案 地理导航 高级搜索 用户

Item : TROMPE ET TAMBOUR :41-15

编辑 复制 添加到播放列表 前一个 下一个

标题	TROMPE ET TAMBOUR
原始标题/翻译	OLU BOY
收集者	
选集	CNRSMH_I_1970_012
录音日期	十一月 1, 1960 . 十一月 30, 1960
上次修改	十月 24, 2012, 5:39 p.m. (admin)

地理和文化信息

音乐信息

号码	作品	当地名字	解释(翻译)
1	Trompe	KAKELE	
1	Tambour frappé	BOYDUNULE	

存档数据

密码	CNRSMH_I_1970_012_041_15
原始密码	BM.1970.012.001/46:41-15
项目号	:41-15
评论	LD, 1/2 piste;ATP (dupli-accél)-

专业数据

Spectrogram Log

分析		书签
性能	价值	单元
Channels	1	
Duration	0:00:28.73	s
Max level	-3.816	dBFS
Mean DC shift	-0	%
MIME type	audio/x-wav	
Resolution	24	bits
RMS level	-19.12	dBFS
Samplerate	48000	Hz

Contextual Information example: Collection

Desk Archives Geo Navigator Advanced search Users

Collection : Les danses du monde

Edit Copy Add item Add to playlist

41 items

Reference	CNR-5741106/07
Title	Les danses du monde
Depositor / contributor	Zemp, Hugo et al.
Recording context	Terrain
Recording period	1952 - 1998
Year published	1998
Corpus	Editions Musée de l'Homme-CNRS, Les disques compacts (CD)
Last modification	May 29, 2013, 4:29 p.m. (e.beaumont)

Geographic and cultural informations

States / nations	Afghanistan, Afrique du Sud, Bénin, Bolivie, Brésil, Bulgarie, Burkina Faso, Centrafrique, Côte d'Ivoire, Cuba, Dahomey, Empire Centrafricain, Ethiopie, France, Gaule, Guinée, Guinée française, Guyane française, île des Amis, Inde, Indes néerlandaises, Indonésie, Iran, Italie, Maroc, Nouvelle-Calédonie, Oubangui-Chari, Papouasie-Nouvelle-Guinée, Perse, Philippines, République de l'Équateur, Roumanie, Royaume d'Italie, Royaume de France, Salomon, Tchad, Territoire de Papouasie et Nouvelle Guinée, Tonga, Vietnam
Populations / social groups	'Are'Are, Dan, Dorzé, Iatmul, Ida Ounidif (Berbères), JORAI, Kaluli, Kanak, LLAMERO, Malinké, Palawan, Pashai, Peul, SENOUFO, SOUS-GROUPE FODONON, Shuar, TARABUCO, Teda, Toraja, TORIFOU, Wayapl, WE/GUERE, Xhosa, Yafar, YORUBA-IFE, Zande

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- Rumba populaire de la Havane CD2_22
- Danse pour Khevissé, Vodoun de la foudre CD1_05
- Masque de danse degli CD1_07
- Orchestre de xylophone jegale CD1_08
- Chant à tenore CD1_15
- Cérémonie de possession : morsure tareroulée CD1_16
- Théâtre dansé kathakali CD2_04
- Flûte kékéve CD2_08

Contextual Information example: Item

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Item : Danse des garçons, umtshotsho / Chant Nontyolo CD1_01

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Title	Danse des garçons, umtshotsho / Chant Nontyolo
Collector	Dargie, Dave
Collection	CNRSMH_E_1998_017_001
Recording date	Jan. 1, 1982 - Dec. 31, 1982
Last modification	June 24, 2013, 11:35 a.m. (e.beaumont)

Geographic and cultural informations

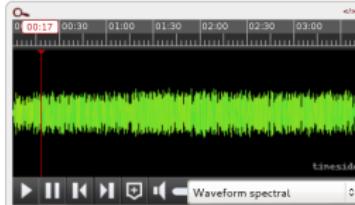
Location	Afrique du Sud, Afrique australe, Afrique
Location details	Sikhwankenqi, au sud de Lady Frere, Eastern Cape Province
Population / social group	Xhosa
Ethnographic context	Chanteuses menantes : Nothulethu Polowana et Nofuniswa Mehlo.

CD.1 - Afrique / Afrique du Sud

«Comme tous les chants des Xhosa, le chant intitulé Nontyolo est caractérisé par une forme cyclique et respiratoire. Ici, c'est l'arc musical frotté (umrhube), joué par une jeune fille, qui tient le rôle de la chanteuse menante (ligne H1 de la transcription; H = hlabeli ; « menant »). Six autres filles chantent les parties des suivantes (L1 à L5 ; L = landela, « suivant »). Elles choisissent leurs lignes mélodiques pendant que l'arc musical continue à jouer la même ligne mélodique (H1). En modifiant le volume de la cavité buccale, la joueuse de l'arc musical sélectionne les harmoniques des deux sons fondamentaux pour en faire la mélodie.

Les lignes des « suivantes » (L1 et L2) sont en fait des parties en polyphonie parallèle (appelées en xhosa intlubo, « variations ») de la ligne « menante » (H1). Pour cette raison, ces lignes commencent au même point rythmique que H1 (indiqué par une double barre). Les lignes L3, L4 et L5 sont des parties polyphoniques en tullage, commençant à un autre point du cycle (L3 et L4 sont intlubo, c'est-à-dire des parties parallèles utilisant le même texte et les mêmes tons de la langue). La polyphonie est basée sur les harmoniques de l'arc musical, mais d'autres « sons non harmoniques » sont également utilisés.

Les Xhosa emploient des rythmes complexes, souvent deux ou plusieurs rythmes simultanément, et l'art du déguisement rythmique est très



Analysis			Markers	
Property	Value	Unit		
Channels	2	s		
Duration	0:03:44.82	%		
Max level	-8.327	dBFS		
Mean DC shift	0.072	%		
MIME type	audio/x-wav			
Resolution	16	bits		
RMS level	-22.108	dBFS		
Samplerate	44100	Hz		

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