Ambisonics Directional Room Impulse Response as a New SOFA Convention

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Outline

Outline

Presentation

About us

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 732130

CONSORTIUM:

https://binci.eu/ info@binci.eu

Presentation

About us

Main objectives of BINCI project:

- Developing production tools to encourage the creation of binaural contents
- Creating three binaural productions showcased and tested in three cultural and touristic sites
- Integrating software and hardware solutions for a complete immersive audio experience

Fundació Joan Miró
Barcelona
Specifically composed music tour, evoking an atmospheric approach to Joan Miró's work.

St. Andrews Castle
Scotland
Multi-sensorial audio-VR experience, re-creating history.

Alte Pinakothek
Munich
Character-based family tour, bringing paintings to life.

BINCI

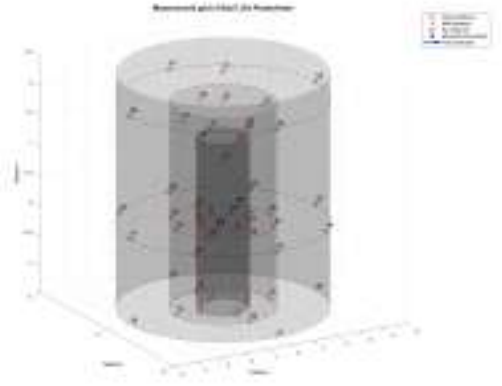
St Andrews Castle






BINCI

Die Alte Pinakothek



BINCI

Fundació Miro

Outline

Ambisonics DRIRs

Impulse Responses

HOW?

- Logarithmic sweep sine technique for recording the RIR[1]
- All microphone's capsules recording at the same time, for each source position
- A to B format conversion either on live inputs or in post-processing
- Impulse is obtained after deconvolution on each Ambisonics channel
- Each source position is measured using a combination of laser meters that give the azimuth, elevation and distance

[1] Simultaneous Measurement of Impulse Response and Distortion with a Swept-Sine Technique, A. Farina, Proc. AES 108th conv, Paris, France

Ambisonics DRIRs

Impulse Responses

WHAT FOR?

- Auralization [2]
- Room acoustics analysis [3] and modelling [4]
- Recording room acoustics for posterity [5]

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[2] Object-based reverberation encoding from first-order Ambisonic RIRs, P. Coleman, A.Franck, D.Menzies, P.Jackson, Proceedings of the 142nd AES Convention, Berlin, Germany

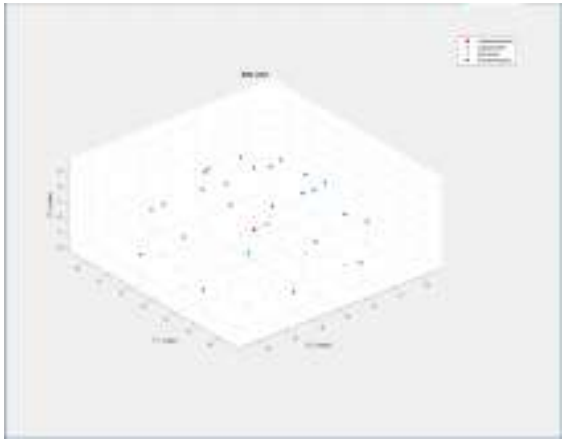
[3] Measurement of 3D Room Impulse Responses with a Spherical Microphone Array, J.J. Embrechts, Euronoise 2015

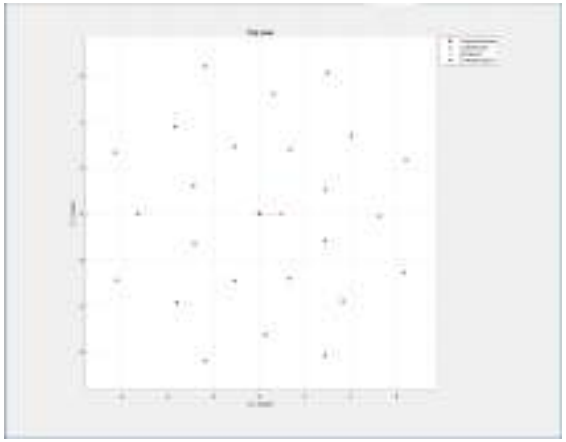
[4] Diffuse Field Modeling Using Physically-Inspired Decorrelation Filters : Improvements to the Filter Design Method, D. Romblom, JAES, Vol. 65, No. 11, November 2017

[5] Recording Concert Hall Acoustics for Posterity, M. Gerzon, JAES Volume 23 Issue 7 pp. 569, 571; September 1975

Ambisonics DRIRs

Eurecat: 3D Tent





Outline

SOFA

The problem

Different conventions for different HRTF datasets...

SOFA

The problem (again)

Kemar (diffuse)

SOFA

The problem (again)

SADIE (Subject 001)

SOFA

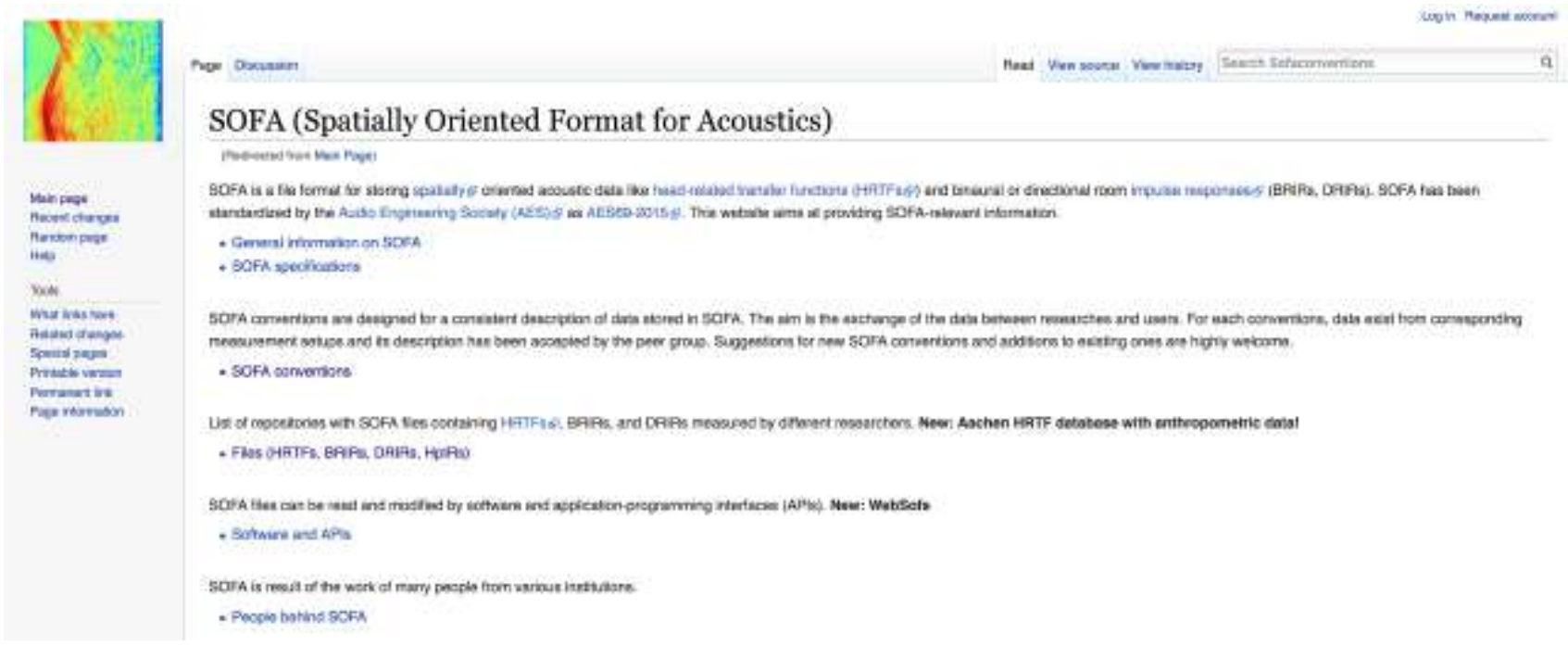
SOFA Conventions

Majdak, Piotr, et al.
"Spatially oriented format for acoustics: A data exchange format representing head-related transfer functions.
Audio Engineering Society Convention 134.
Audio Engineering Society, 2013.

AES69-2015 Standard

SOFA

SOFA Conventions



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SOFA (Spatially Oriented Format for Acoustics)

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SOFA is a file format for storing spatially oriented acoustic data like head-related transfer functions (HRTFs) and binaural or directional room impulse responses (BRIRs, DRIRs). SOFA has been standardized by the Audio Engineering Society (AES) as AES69-2015.

- General information on SOFA
- SOFA specifications

SOFA conventions are designed for a consistent description of data stored in SOFA. The aim is the exchange of the data between researches and users. For each conventions, data exist from corresponding measurement setups and its description has been accepted by the peer group. Suggestions for new SOFA conventions and additions to existing ones are highly welcome.

- SOFA conventions

List of repositories with SOFA files containing HRTFs, BRIRs, and DRIRs measured by different researchers. **New: Aachen HRTF database with anthropometric data!**

- Files (HRTFs, BRIRs, DRIRs, HpIRs)

SOFA files can be read and modified by software and application-programming interfaces (APIs). **New: WebSofa**

- Software and APIs

SOFA is result of the work of many people from various institutions.

- People behind SOFA

SOFA

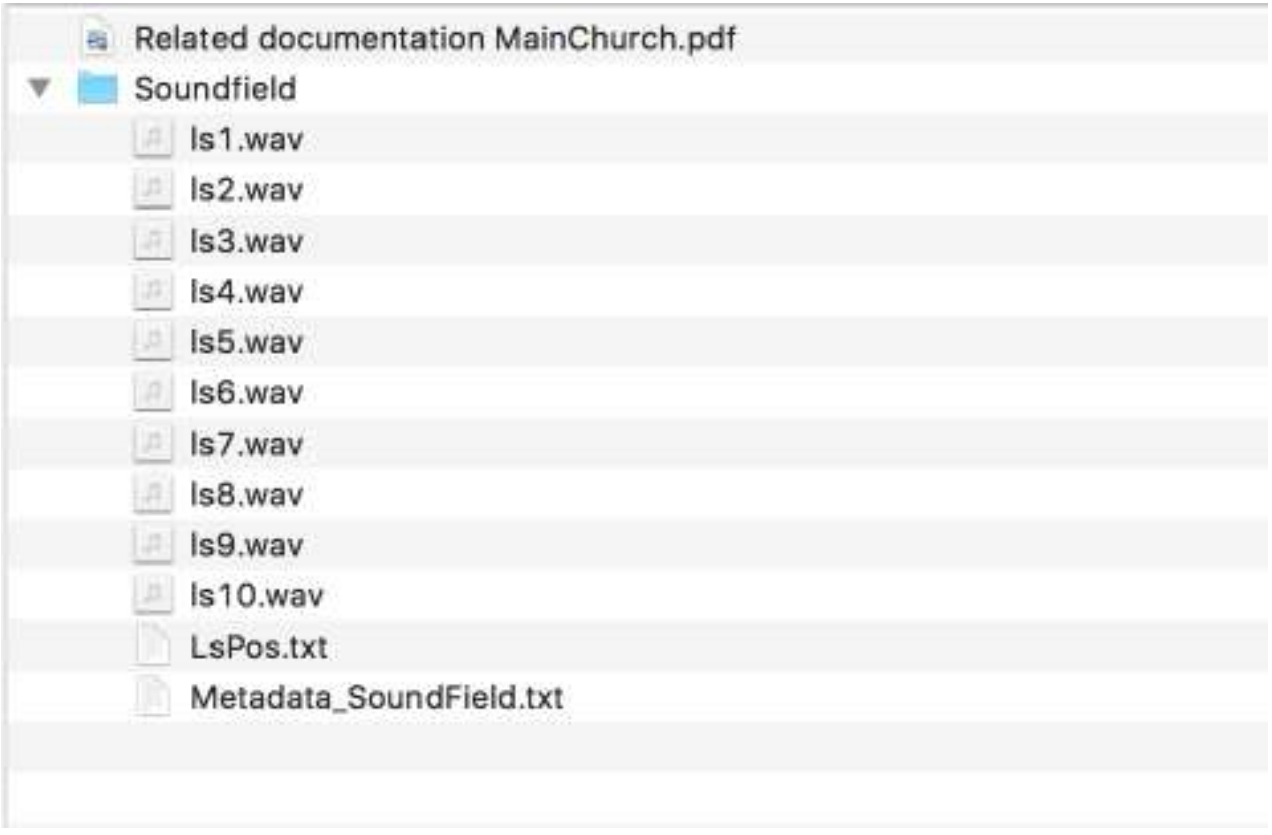
The problem (again)

Different conventions for different AmbisonicsDRIR datasets...

SOFA

The problem (again)

Main Church (S3A)



SOFA

The problem (again)

Guildhall Court Chamber (OpenAIR)

SOFA

The problem (again)

QMUL Octogon (Isophonics)

Download

All files are zip files. Each IR is a 96 kHz, 32 bit wav file.

- Documentation (photo of room, diagram of layout) and sample IR (1.8 MB)
- Omnidirectional (60.3 MB)
- W of B-format (64.3 MB)
- X of B-format (64.5 MB)
- Y of B-format (63.4 MB)
- Z of B-format (62.9 MB)

SOFA

Candidates?

Requirements:

1. Multiple speakers
2. Multiple microphone positions
3. Audio in Ambisonics domain
4. Ambisonics-related information

SOFA

Candidates?

Convention candidates:

- SingleRoomDRIR

SOFA

Candidates?

Convention candidates:

- SingleRoomDRIR
- MultiSpeakerBRIR

SOFA

Candidates?

Convention candidates:

- SingleRoomDRIR
- MultiSpeakerBRIR
- GeneralFIRE

AmbisonicsDRIR convention (v0.1)

SOFA

Proposal

Based on *GeneralFIRE*, with following additions:

- Global attributes: *AmbisonicsOrder*, *AmbisonicsMicrophoneModel*, *AmbisonicsConversionMethod*
- Variables: *ListenerUp*, *ListenerView*, *EmitterUp*, *EmitterView*
- *Data* attributes: *ChannelOrdering*, *Normalization*

SOFA

Proposal

Data type: FIRE

- M: Number of measurements (*Listener* positions)
- R: Number of *Receivers* (Ambisonics channels)
- E: Number of *Emitters* (speakers)
- N: Number of audio samples

Main Church (S3A)

SOFA

Examples

	Ls1	Ls2	Ls3	Ls4	Ls5	Ls6	Ls7	Ls8	Ls9	Ls10
X(m)	0	2.50	2.50	-2.50	-2.50	0	-4.70	4.70	-4.70	4.70
Y(m)	5.00	4.33	4.33	4.33	4.33	5.00	-1.71	-1.71	-1.71	-1.71
Z(m)	0.06	1.15	0.06	1.15	0.06	1.15	0.06	1.15	1.15	0.06

SOFA

Examples

- M: 1
- R: 4
- E: 10
- N: 65536
- *ListenerView*: [0, 1, 0] (*type*: cartesian, *unit*: meter)

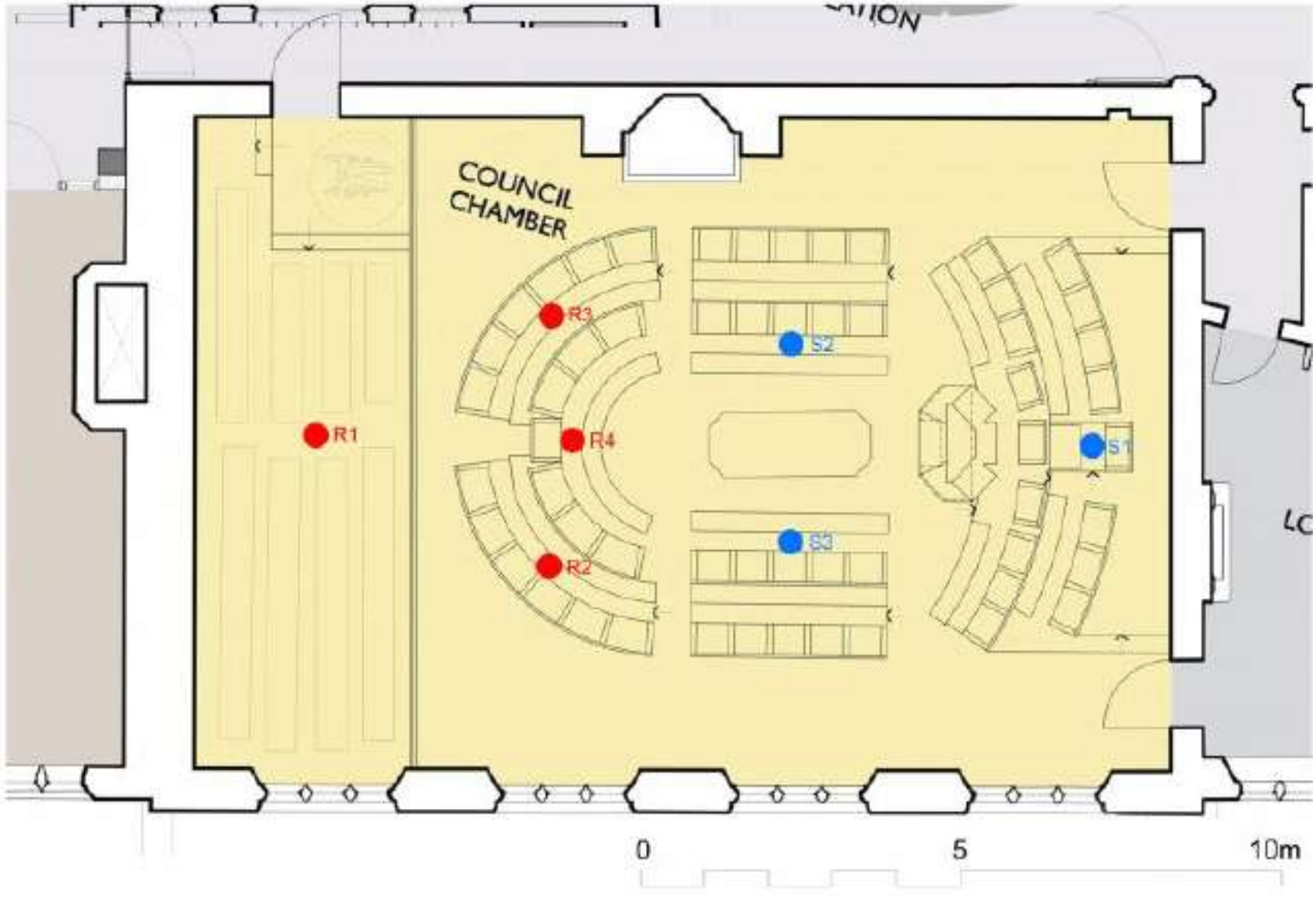
SOFA

Examples

Guildhall (OpenAIR)

SOFA

Examples



SOFA

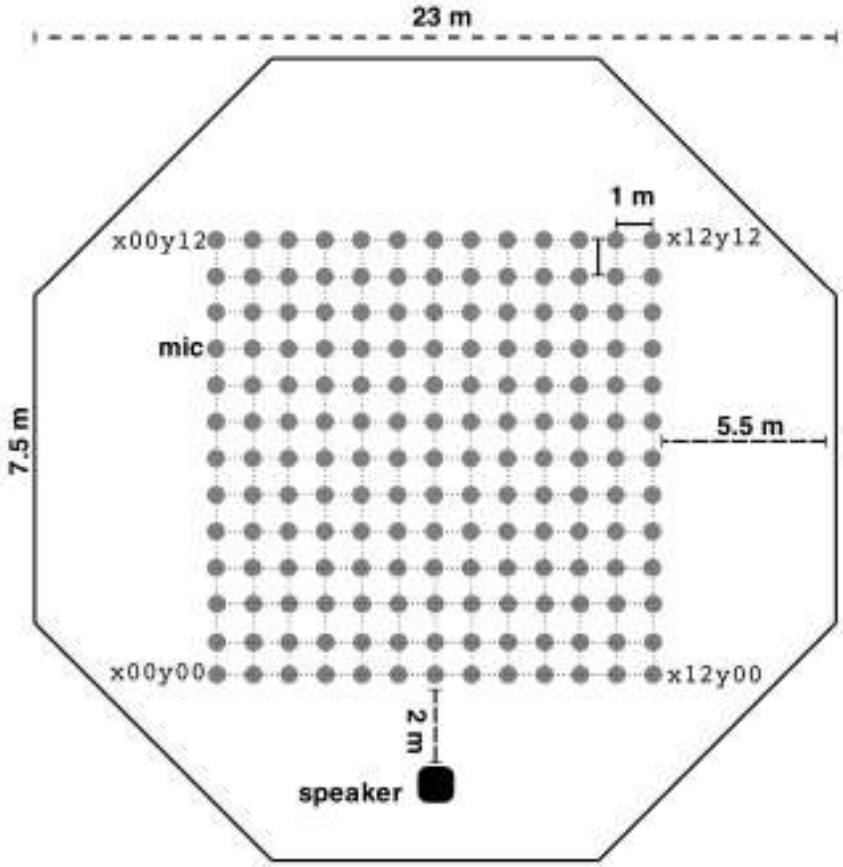
Examples

- M: 4
- R: 4
- E: 3
- N: 480000

QMUL Octogon (Isophonics)

SOFA

Examples



SOFA

Examples

- M: 169
- R: 4
- E: 1
- N: n

SOFA

Links

Matlab/Octave API:
https://github.com/jdemuynke/API_MO

C++ API:
https://github.com/andresperezlopez/API_Cpp

Thanks.

Questions?