**LCAV – Audiovisual Communications Laboratory  
EPFL I&C Semester project 2020, Spring Semester  
Project description and planning**

**1. Project Description**

*This section is filled in by the project supervisor.*

**1.1. Title:** Multichannel Direction of Arrival Estimation

**1.2. Description (around half a page):**

Recent work has shown that it is possible to estimate the direction of arrival (DoA) of a sound using just one microphone, albeit a special one surrounded by LEGO bricks [1]. The idea is that the LEGO scatters the incident sound providing a special directional signature that we can use to estimate the DoA. In the multichannel case, the additional scattering is not a priori necessary for localization. The question is then whether it is helpful to have scattering. The goal is to compare various localization algorithms with and without the presence of scattering, first through numerical simulations then time-permitting a real experiment can be done.

[1] D. El Badawy and I. Dokmanic, “*Direction of Arrival with One Microphone, a few LEGOs, and Non-Negative Matrix Factorization,*” IEEE/ACM Transactions on Audio, Speech and Language Processing, 2018.

**1.3.** **Type of Work (e.g., theory, programming):** 50% Research, 50% Coding

**1.4. Prerequisites (e.g., signal processing for communications, C++):** Signal processing, programming in python

**1.5. Supervisors:** Dalia El Badawy

**2. Student Information**

*This section is filled in by the student.*

Name: Antonio Morais

E-Mail: antonio.morais@epfl.ch

School (e.g., I&C, STI): I&C

Program (Comm. Sys., Comp. Science): Computer Science

Cycle (B.Sc./M.Sc./EDIC): M. Sc.

Semester (1, 2, 3, ...): 4

**3. Project Planning**

*This part is filled by the supervisor and discussed with the student. It should be completed and agreed upon before the end of the 2nd week (hard deadline on the4th March 2020) and sent to the responsible person (adam.scholefield@epfl.ch). After the submission of the plan, a modification is still possible, but it should be motivated at the midterm or the final presentation.*

**3.1. Deliverables:**

*Explain in a few sentences the expected concrete outcome of the project (e.g., a C program that removes red eyes, a Matlab simulation of sound propagation in a room, a subjective test on N persons of an algorithm).*

*1. Report with all results*

*2. Code to reproduce results*

**3.2. Timeline:**

*Explain shortly (in a few sentences) what the student should achieve for every week of the project in order to reach the final goal described in the previous section. Please remind that the students are supposed to spend 30 hours to prepare the required background before the beginning of the semester (e.g., reading papers, revising Matlab/C). The amount of work during the semester should correspond to 12 hours per week. After the end of the semester, 30 extra hours should be spent to complete report and presentation.*

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| **Week #** | **Planned Work** |
| 1 | Reading baseline algorithms |
| 2 | Foward modeling and baseline algorithm (stacking) |
| 3 | Research different algorithms (Music, stacking etc) to implement. Compare scattering to non-scattering. |
| 4 | Explore multichannel nmf |
| 5 | (Pyroomacoustics) Creation of a first model to use with PyRoomAcoustics + study of PyRoomAcoustics |
| 6 | (Pyroomacoustics) Research for the model and start of the implementation of the model |
| 7 | (Pyroomacoustics) First implementation of the model done and some tests using PyRoomAcoustics + Midterm report |
| Midterm presentation. | |
| 8 | Start of the coding of the different algorithms to use in the simulation (baseline algorithms for reverberation) |
| 9 | Easter holidays |
| 10 | Coding of the simulation (reverberant case) |
| 11 | Try deep learning-based approach |
| 12 | Numerical results comparing scattering to non-scattering |
| 13 | Real experiments |
| 14 | Real experiments |
| 15 | Start report |
| Final presentation.  Report due 05.06.2020  Grades due 22.06.2020 | |