

Lab Internships Faculty of Electrical Engineering and Computer Science

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| Topic: | Robotic Agent for Field Acoustics (RAFA) |
| Areas/Study fields: | Electrical Engineering, Acoustic Engineering, Robotics |
| Duration: | 3-6 months |
| Deadline for applying: | February 15 for fall internship October 1 for spring internship |
| Supervisor: | Prof. Dr.-Ing. Benjamin Lehmann |
| Abstract: | <p>When sound travels from a source to a microphone within an enclosed space, it undergoes various interactions with the surrounding environment. These interactions include delay and attenuation caused by distance, as well as reflections, absorption, and diffraction due to the presence of walls, floors, ceilings, furniture, and other obstacles. The resulting echoed signal, known as the Room Impulse Response (RIR), can typically be decomposed into three distinct components:</p> <ul style="list-style-type: none"> • Direct path: the initial sound wave traveling straight from the source to the microphone, • Early reflections: first-order echoes resulting from major surfaces like walls and floors, • Late reverberation: a dense cluster of echoes resulting from multiple, complex reflections throughout the room. <p>This project investigates a central question: Can the Room Impulse Response be used to infer the shape or structure of a room, particularly in simple geometries? To explore this, a TurtleBot4 – a mobile robot platform equipped with audio recording capabilities (Red Pitaya) – is used to autonomously measure the RIR at various positions within a room. Different materials (e.g., acoustic foam, curtains, wooden panels, glass) and configurations will be tested to observe their effect on the RIR.</p> |
| Tasks: | <ul style="list-style-type: none"> - Designing and executing an experimental setup using the TurtleBot4 & Red Pitaya. - Capturing RIRs in rooms with varying shapes and surface materials. - Analysing the captured impulse responses in terms of timing, amplitude, and spectral content. - Investigating the relationship between RIR characteristics and the room's geometry or materials. - Exploring available tools and algorithms for RIR analysis and room reconstruction (e.g., deconvolution methods, image-source models, machine learning approaches). |

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| Prerequisites: | <ul style="list-style-type: none"> - Basic knowledge of signal processing - Linear algebra and geometry - Programming Skills: Python or MATLAB - Soft Skills: Curiosity and willingness to experiment, Ability to work independently and in teams |
| Language requirements documents: | <ul style="list-style-type: none"> - English (minimum B2) - Transcript of Records - CV |
| Starting point: | <p>October for fall internship April for spring internship</p> <p>Earlier/later beginnings may be possible, depending on professor's availability.</p> |
| Credits: | 6 ECTS |
| Salary: | None paid internship, HSB scholarship for none Erasmus students subject to availability. This will be announced on short term notice. |