



The **French-German Research Institute of Saint-Louis (ISL)** situated in the border triangle of Germany, France and Switzerland is an internationally renowned research institute belonging to a global industrial and economic network. The spectrum of our core activities comprises a variety of topics: aerodynamics, energetic and advanced materials, lasers and electromagnetic technologies, protection, security and situational awareness. Our activities are related to both basic and applied research.

ISL is offering a **PhD Position**

**Research field: Protection technologies, security, situational awareness**

## **Taking into account bone conduction in the characterization of a hearing protection: elaboration of an objective method**

Testing hearing protection attenuation is currently realized by two kinds of methods: subjective (related to instrument's reading) and objective (related to listener's reading). Among them three methods are most useful:

1. The subjective method of real-ear attenuation at threshold (REAT) implemented either in a free sound field or under earmuff.
2. The objective method of placing a microphone in real ear (MIRE).
3. The objective method consisting in measuring attenuation with an acoustical test fixtures (ATFs, ISL artificial head for impulse noises).

The bone conduction contribution is partially taking into account in the subjective methods but in these methods the occlusion effect is not compensated and the high level noise dependence is not considered (eventual nonlinearity). In another way, subjective methods are time consuming and difficult to organize.

The proposed work is to study and realize an objective model of the bone conduction with the aim to be included in a measurement setup. The link with actual standard and future possible evolution of standards will be also studied.

### **The main tasks of the work will be:**

1. State of the art of the existing evaluation of bone conduction in regards of hearing protectors attenuation testing but also in regards of the physical aspect of bone conduction
2. Study of the linearity (dependence of the noise level) of the bone conduction and evaluation in comparison with subjective method (REAT, MIRE)
3. Study of the influence of the occlusion effect in subjective methods
4. Realization of an objective model of bone conduction with sensors and/or with a theoretical approach, including the results of the linearity of bone conduction and influence of occlusion effect.

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