**Spiking Neural Network in autonomous vehicle**

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## Background information

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| **Profil:** | Master student |
| **Period:** | 6 months |
| **Salary:** | 4,35 euros par hour |
| **Place:** | ENSISA, UHA, Mulhouse |
| **Deadline:** | Thanks to postulate before 10/01/2026 |

## Context

In a context where demand for increasingly fast, energy-efficient intelligent systems capable of processing complex temporal data continues to grow, spiking neural networks (SNNs) are emerging as a major technology [1]. Inspired by the biological functioning of the brain, SNNs process information in the form of discrete events—spikes rather than using continuous values like traditional neural networks (see Figure 1). This event-driven approach not only significantly reduces energy consumption, but also enables more natural and efficient processing of dynamic signals such as sensory data, real-time streams, and human-machine interactions [2]. These characteristics make them ideal candidates for integration into the end-to-end control of autonomous vehicles [3].

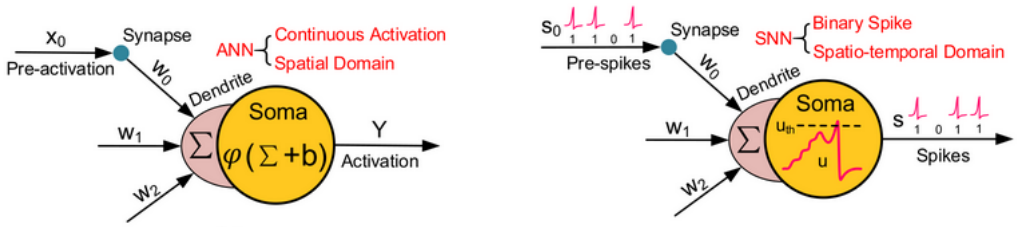


Figure 1 – Comparaison entre ANN et SNN

In a classic architecture, the functionalities enabling autonomous vehicle control are divided between perception, decision-making/planning, and control, arranged in a cascade (pipeline mode). This modular approach has the advantage of allowing each functionality to be validated independently, but can reveal problems of data loss or congestion at each input. With the advent of methods based on artificial intelligence and deep neural networks, a unified architecture, known as end-to-end, is able to provide control signal directly from raw sensor data (see Figure 2. Two learning methods enable this design. The first is through driving imitation, and the second is through reinforcement learning [4,5,6].

Nevertheless, numerous issues remain, both in the use of SNN networks and in end-to-end architecture. These include, on the one hand, the lack of benchmarks to illustrate their performance and, on the other hand, the lack of markers to identify the internal functioning of the architecture.

## Objectives

This internship is part of a research program aimed at developing a new end-to-end autonomous driving architecture adapted to specific missions. It should enable the first steps to be taken toward etablishing SNN networks dedicated to decision-making in the case of overtaking maneuvers. The main objectives are : (1) through an exhaustive state-of-the-art review, to propose a decision-making method for triggering the maneuver, (2) to implement the method on a GPU or neuromorphic system

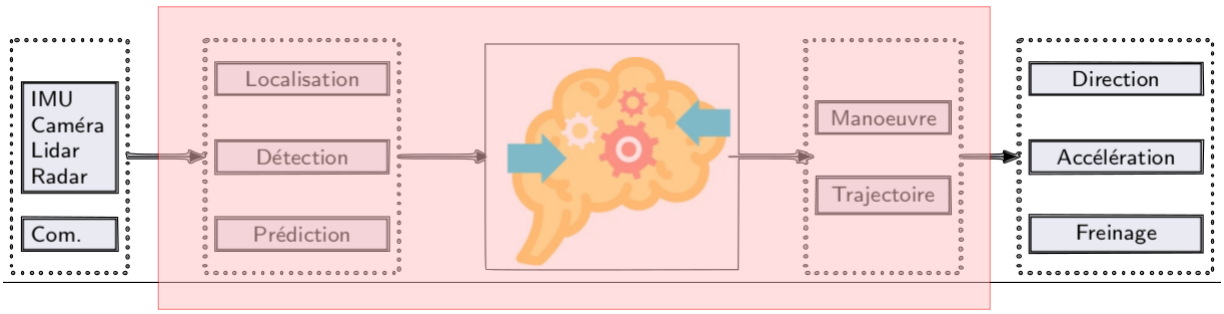


FIGURE 2 – End-to-end architecture

by interfacing it with a road traffic simulator (CARLA), (3) and finally, to propose a benchmark for comparing the proposed solution with traditional ANN-type solutions.

Trips to partner laboratories (France/Compiègne, Luxembourg/Luxembourg City, Canada/Waterloo) may be considered in order to benefit from technical expertise on the test platforms.

**Mots-clé :** autonomous vehicle, artificial intelligence, neural networks

**Applicants are invited to submit their curriculum vitae, statement of purpose, and academic transcript(s) to the following contacts :**

## Contacts

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## References

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