

STRETTO IN CARENA

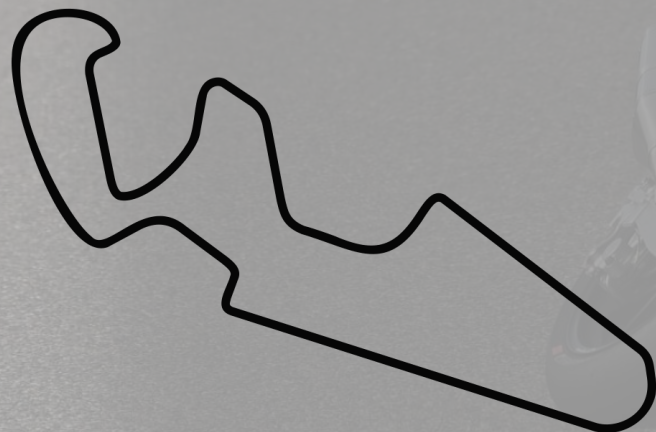
L.I.V.I.A





**moto
student**

 **18 MESI**



**MOTORLAND
ARAGON**



80 Team



19 Nazioni



**petrol
moto student**

I NOSTRI PROTOTIPI

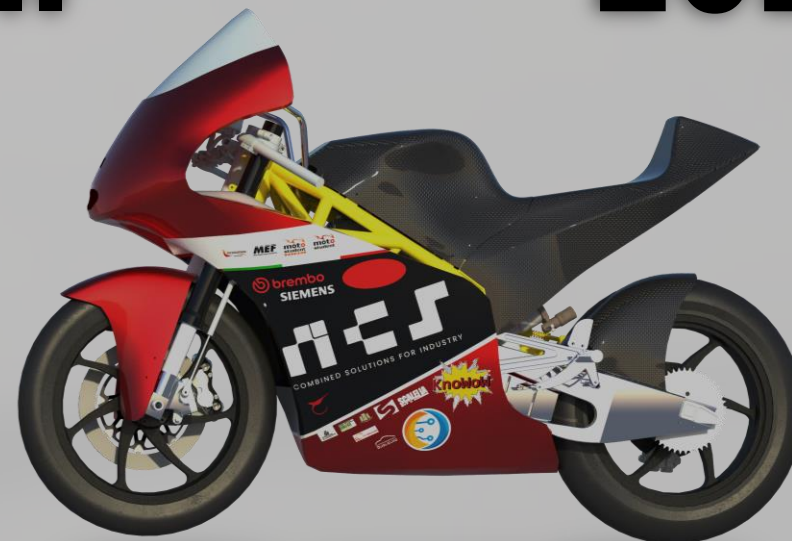
2020

VI



VII

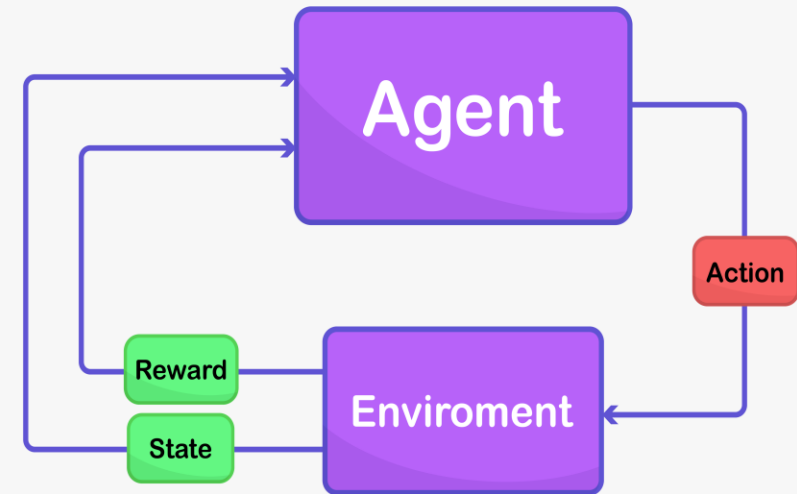
2023



Neural Network

Learning-based
Intelligent
Vehicle
Information
Analysis

Reinforcement learning



AGENT

Neural Network algorithm

ENVIROMENT

the track in exam, and could be well-known track like **Aragon**, **Vallelunga** and also custom track

REWARD

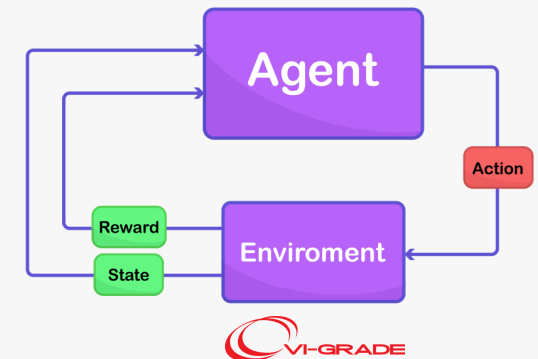
the **performance** of the vehicle

STATE

Set-up of the vehicle in exam

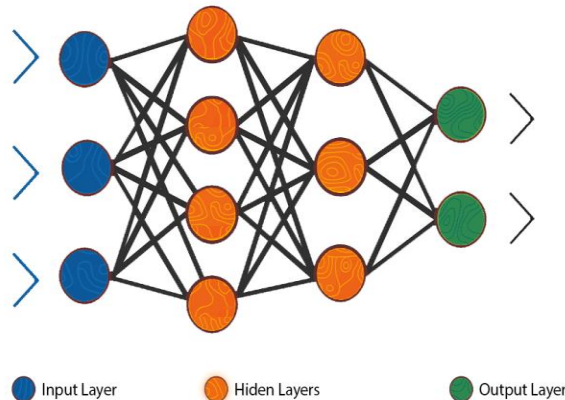
ACTION

are all possible changes of configuration: **suspension stiffness**, and so on



RL : Agent

NEURAL NETWORK



The agent is the entity that makes decisions by interacting with an environment and receives feedback in the form of rewards or penalties.



In this case, the agent makes decisions by interacting with the circuit under predefined conditions in order to maximize the reward, which consists of the vehicle's performance.

RL : Enviroment

The environment is a model or simulation with which the agent interacts, taking actions and providing not only reward signals but also the new state after each action.

RL ENVIROMENT



RL : Reward

The reward function is what characterizes the performance of the vehicle.

$$reward = (objectives - penalty_{crash})$$

"Objective" in this context refers to a series of pieces of information that one wants to use to represent performance:

- Lap time attack
- Average lap time
- Performance trend
- Etc

LAP TIME ATTACK

$$Res = \begin{cases} Res + (\Delta_{lapTime} * n_{changes}) & \text{laptime}_t > best_t \\ 0 & \text{laptime}_t = best_t \\ \Delta_{lapTime} * n_{changes} & \text{laptime}_t < best_t \end{cases}$$

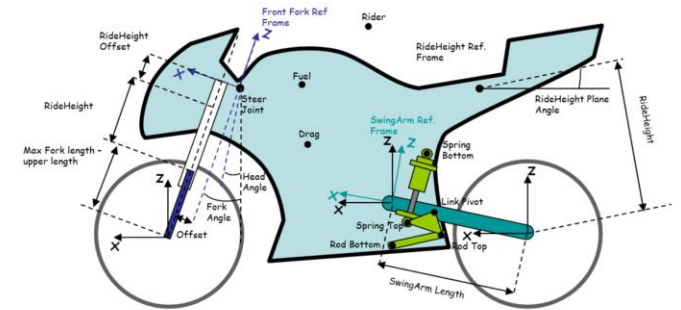
RL : State

The state of an RL model specifies the conditions under which the vehicle and the environment are operating. In this case, it refers to the motorcycle setup. Additionally, it's possible to add further parameters regarding the characteristics of the circuit so that it's more adaptable to changes in the environment.

Extra state

- More complex SetUp
- Environmental Parameters:
 - Characteristics of the various sectors of the circuit
 - Environmental conditions
 - Road surface conditions

SETUP



ENV PARAMETERS



RL : Action

The ACTIONS are a set of operations that change the state in which the vehicle and the environment interact, consequently affecting the obtained results. The adjustable parameters are those related to the vehicle, particularly:

- Stiffness and preload of the front suspension
- Stiffness and preload of the rear suspension
- Gear ratios
- Motorcycle wheelbase

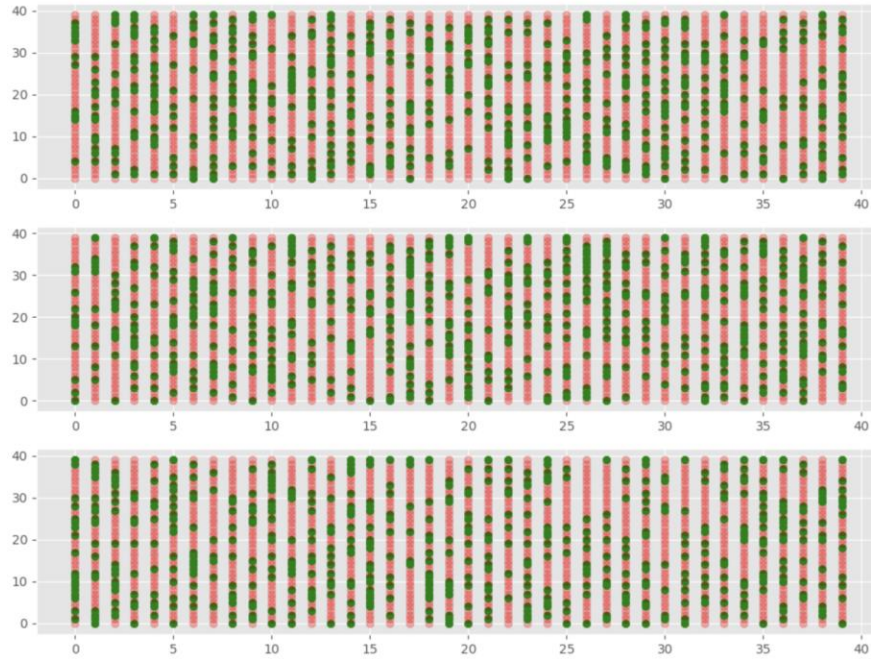
State of Arts

The network has been analyzed and subsequently trained considering a subset of data, taking into account the previously illustrated structure, particularly:

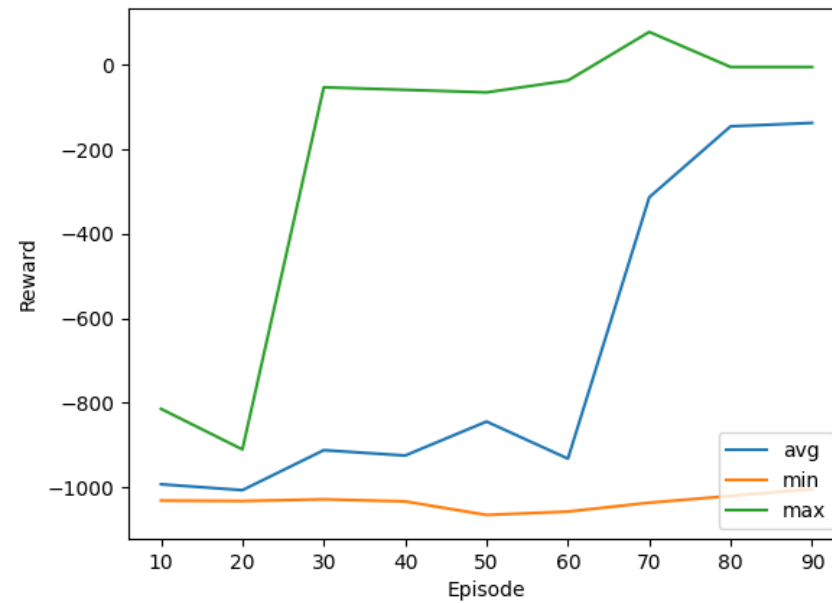
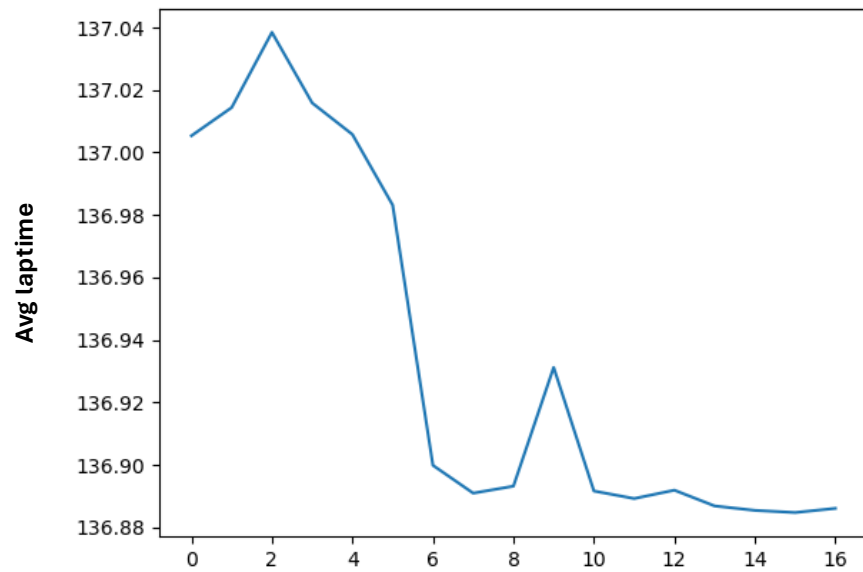
- **4 Parameters for the setup:**
 - Front suspension (stiffness and preload)
 - Rear suspension (stiffness and preload)
- **60,000 laps evaluated for training**
- **Environment:**
 - Aragon Circuit under standard conditions
- **Mathematical model of the vehicle:**
 - SIC Motorcycle

Results

ACTIONS



Results



Validation



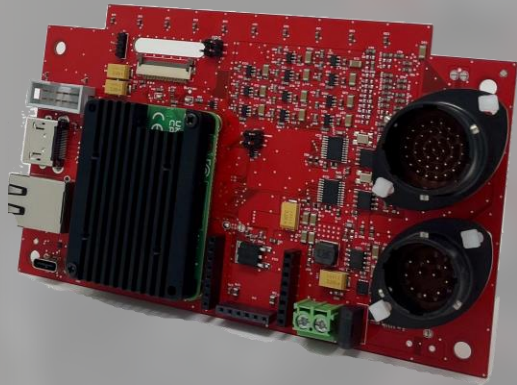
**Analyze
Loss and val-loss
Of RL**

**Analyze the
Setup and the
laptime**

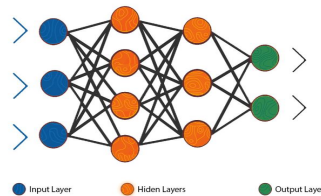
**Analyze the
simulation
telemetry**

**Comparing the
result with the
real laps**

Feature Developments



NEURAL NETWORK



Integration of NN directly on the acquisition board

- Additional information to display to the rider during the testing session
- Training and adaptation to the pilot's driving characteristics

Increasing the complexity of the model to make it more realistic

- Adding parameters for the motorcycle

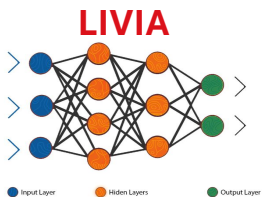
Feature Developments

TODAY

2025

2024/
2025

2025/
2026



Feature Developments

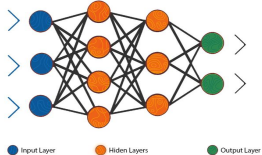
SIC Academy
Spin-off

2025

2024/
2025

2025/
2026

LIVIA



Feature Developments

SIC Academy
Spin-off

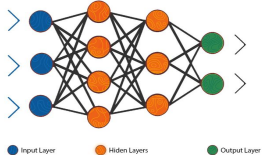
Integration
LIVIA on
board

2025

2024/
2025

2025/
2026

LIVIA



Feature Developments

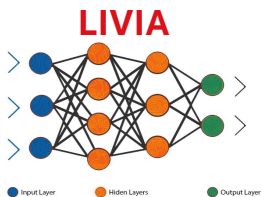
SIC Academy
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Integration
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2025

2024/
2025

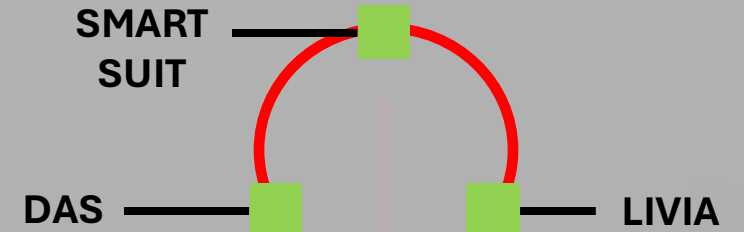
2025/
2026



Feature Developments

SIC Academy
Spin-off

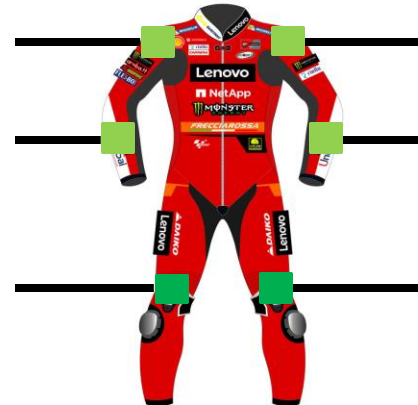
Integration
LIVIA on
board



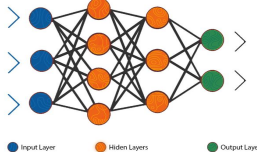
2025

2024/
2025

2025/
2026



LIVIA





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