HACKATHON: PRACTICAL WORK

Problem Formulation and Recommendations

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Outline

Problem Formulation

input of the Problem

As a Problem input consider a simplified (kinematic) model of a Racing Car (RC) introduced in Lecture. One can be presented as

$$\begin{aligned} &\mathrm{math.cos}(x[2]) \times v[0], \\ &\mathrm{math.sin}(x[2]) \times v[0], \\ &(v[0]/l) \times \mathrm{math.tan}(\phi) \end{aligned} \tag{1}$$

The Control of the car is: $u := (\phi, v)^T$, namely, the orientation angle ϕ and the velocity magnitude v. The given reference trajectory $g(x, y) = 0$ constitutes a closed curve, where x and y are Euclidean coordinates of a stationary system coordinates.

Problem Formulation

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Using the Reinforcement Learning approach define the optimal RC control $u^{opt} := (\phi^{opt}, v^{opt})^T$ such that:

- the integral deviation (or integral quadratic deviation) of the corresponding optimal trajectory of the RC and a given reference trajectory $g(x, y) = 0$ is minimal;
- the racing time t_f is minimal.

For the computer oriented solution of the above Problem use the Python ML resources and generate the corresponding Python - code.

Problem Formulation

output of the Problem

As a computational output of then Problem consider:

- the dynamic relation $\phi^{opt}(t)$ on the obtained optimal trajectory;
- the dynamic relation $v^{opt}(t)$ on the obtained optimal trajectory;
- the average speed of the RC;
- the obtained optimal (minimal) time t_f^{opt} of the racing.

One can also present some additional Problem outputs: the maximal quadratic deviation of the optimal pair $(\phi(t), v^{opt}(t)$ from the given reference point (the medium line of the lane).

Problem Formulation

output of the Problem

As a code-related output of then Problem consider: the complete Python-code including the following parts

- model and data simulation part;
- the data-driven model training (learning);
- optimal car steering $=$ optimal tracking control;
- model validation and computational results;
- visualization of the racing.

Some Recommendations

recommended Python ML packages

”pip install tensorflow” (TensorFlow), ”pip install –user tf-agents[reverb]” (TensorFlow Agents), installation of the usual Python packages.

recommended Python libraries

One also can use ”keras” (Python Deep Learning API), ”PyTorch” (Python ML library), and the packages mentioned in Lecture.

Presentation of the Obtained Results

- presentation of the computational results;
- presentation of the Python codes.

THANKS!