Predicting Steering Angle
for
Simplified Performance Metrics from Rosbag Data

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Our Team

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3. Katrin Tsepelina
4. Kertu Toompea (self-proposed project idea)
Our Project

Problem - In autonomous driving it is sometimes difficult to measure if a test drive is good or bad. But we need to measure. To know how to continue work towards self-driving vehicles.

Idea - Rosbag includes all the data from a drive. So it must be possible to measure performance using this data. Even if it is a simplified estimation compared to a human.

Questions - How to choose the right input parameter? In reality it is never just one parameter but a combination of many. But to simplify, we can start with just one, right?

ML element - We are going to look at the data, choose one parameter, create a simple model that predicts next step (a value) in time, and then see how good/accurate/bad the prediction is compared to the ground truth (GT). The GT is the recorded data from a human drive on the same road.
Our Project (shortened reminder)

**Problem** - We did another daily drive autonomously. Was it good or bad?

**Idea** - Let’s take the rosbag and see. Not with human eyes, automatically.

**Questions** - Is steering angle a good parameter to choose? Yes! ... For now.

**ML element** - Using a simple model to predict steering angle and see how good is it compared to the ground truth (GT).

GT = recorded data from a human drive on the same track.
Our approach

- Predict **steering angle**
- From **position coordinates** (xy)
- We **don’t** use images
- We do it **per track** (simplification)
- Use **simple** models
Example raw data

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Before vs now
Progress

● Our data from 1 track
  ○ 1 manual drive for training data (GT)
  ○ 1 autonomous drive for testing
  ○ Corrected the coordinates
  ○ Converted the angle (just for faster human understanding)

● Formulated the problem
  ○ and reformulated, and repeated

● Trained
  ○ Different models

● Iterated
  ○ Results >> Went back to the drawing board >> trained

● Find out how others do it
  ○ Searching past materials that use images...
Problems

- We need to draw on a map >> no, we don’t.
- We need to use images >> no, we don’t.
- Draw extra lines to help predict angle >> no need.
- Unrealistic vs realistic accuracy calculation.
- We can use LR >> no >> yes >> no.
- We cannot use classifier models >> yes, we can.
- Different results.
- Re-formulating problem.
- Over-complicating the problem.

You have a problem A. You have trained a model B.

Types of questions to ask:

1. Can we trust these results?
2. How good are they?
3. How can we do better?
Example (snapshot of a work segment)

Input: x, y

Labels: steering angle (deg)
If classifier, needs encoding from float to int.
Encoded: {
  -0.677 : 0,
  -0.676 : 1,
  ...
  2.511 : 1952
}

De-encoded after training.

Accuracy using a threshold <= 2 degrees*

* - On a straight path it is OK for the steering angle to change within 2 degrees.
Results

- Linear Regression
- KNeighbors
- Random Forest

Initially 31% accuracy for predicting steering angle from xy position. (unrealistic)
After applying 2 degree threshold 45% accuracy. (realistic)
After overfitting 97% accuracy.

Expectations:

60-80% accuracy using simple model.
Can use for rough estimation if the drive was good or bad.

Main lessons:

- Simple problems can become complex when taking a closer look. And go beyond course materials.
- Do not get stuck with one method (or too few methods). Get “out of the box” in good time.
- The problem may need re-formulating to apply initially discarded methods. More than one solutions to one problem.
- For example: Linear Regression could be used if we divide the path to tiny segments.
- Try methods that were not introduced in the course.
Thanks to our team

Thanks for listening