CruiseAuto Project – Milestone 4
INSTRUCTIONS: Algorithm Refinement and Final Deliverables

Introduction

General Instructions

Read this document carefully. It provides you with all the requirements needed to complete the M4 Answer Sheet and any coding tasks. You are responsible for following all instructions in this document to complete your work. Use professional language in all written responses. See EPS01 for guidelines [link]. Format all plots for technical presentation. See EPSO2 for guidelines [link]. You will submit all deliverables to Gradescope.

Using & Citing External Resources

When external sources are used, each must be properly cited with (1) an in-text citation referenced in the body of the text and (2) a full citation in *Part 8. References* of the M4 Answer Sheet for each part of this milestone document. Use APA 7th style [help link].

Milestone 4 Context

This project can be completed using only MATLAB commands that have been taught or used in class materials; however, MATLAB has a huge library of built-in functions not necessarily taught in class that can be very useful. Beginning in Milestone 3, you may begin to refine your algorithm utilizing these built-in functions. **If you decide to use a function that was not taught in class, you must document the function name and how it works.** Write several sentences to thoroughly explain the function, how it operates, and the reason you chose to use it. **Replicating the MATLAB help documentation is neither appropriate nor sufficient.** Failure to demonstrate full understanding of a built-in function that you use in your algorithm will result in point deductions.

Milestone 4 Instructions

Part 1: Assignment Header

Complete the following on Page 2 of the M4 Answer Sheet.

Team Information

The assignment header must contain the section number and team ID, team member names, Purdue career account username, and programmer number for each team member in Part 1. *If you are in section 001 and team 3, your section and team ID (SSS_TT) would be 001_03.*

Milestone Work Report

In the Detailed Description of Work, each person on the team should write their own description of how they contributed to this milestone. Be very detailed here. Then in the last column, your team should estimate the percentage of the work that each team member did on this milestone. **This column needs to add up to 100%.** We know this will vary on any given milestone, but one person in the team should not be doing significantly more than the others throughout the whole project. Use this column as a way for you to make sure your workload is balanced throughout the project.

Part 2. Milestone 3 Feedback and Reflection

Based on your feedback from M3, identify at least one strength and one limitation of your team's algorithm created in M3. Consider how the feedback from previous milestones could lead to improvements in your work. Your reflection should provide a clear, useful summary of your M3 feedback and a practical plan to address the issues. Use professional written language to record your answers in Part 2 of the M4 Answer Sheet. Document any references in Part 8 of the M4 Answer Sheet.

Part 3. Algorithm Improvement Plan

In Part 3 of the M4 Answer Sheet, introduce two (2) improvements to your M3 algorithm. You may want to review your ideas from Part 6 of Milestone 3. You will need to include the parameter(s) that the improvement targets and describe in words (not code) the nature of the improvements you plan to implement in your algorithm. Then provide evidence-based rationales for why these refinements are necessary and how they will enhance the performance or accuracy of their algorithm. Use professional written language. Document external references in Part 8 of the M4 Answer Sheet.

Part 4. Algorithm Refinements Implementation and Results

Before you make any changes to your code, resave all your algorithm files with M4 instead of M3 in the file names. You will have at least these files (but you may have more if you created additional UDFs):

→   M4_main_SSS_TT_login.m
→   M4_sub2_SSS_TT_login.m
→   M4_sub3_SSS_TT_login.m
→   M4_sub4_SSS_TT_login.m
→   M4_performance_SSS_TT.m

Implement the outlined improvements to the relevant files. **Clearly comment where you made improvements within the code**, using the text **'Improvement 1'** or **'Improvement 2'** and a concise, meaningful description of the change for each improvement. **Do not delete any code** as you implement the improvements: comment out unnecessary M3 code and comment on the change. Be sure to fill out Part 9 on the M4 Answer Sheet if you used any MATLAB built-in functions not explicitly taught in class (see Milestone 4 Context for more information).

Part 4a. Refinement Results with Benchmark Data

Evaluate the improvements in your algorithm using the benchmark data from M3. Compare the parameters identified for the benchmark data using the algorithm you submitted in M3 and your refined algorithm for M4. This step allows you to compare the percent error of your algorithm against known values of the data. Record your results in Part 4a of the M4 Answer Sheet. Use appropriate decimal places.

Part 4b. Refinement Results with Experimental Data

Run your M3 algorithm and your updated M4 algorithm on the experimental data sets (all 45 tests = 5 tests per vehicle per tire type). You will obtain the parameters for each of the three (3) tire types. You may need to adapt both algorithms to account for the five (5) repeated data sets for the nine (9) vehicle-tire combinations. Record your results in Part 4b of the M4 Answer Sheet. Use appropriate decimal places.

Part 4c. Performance Check with Experimental Parameters

Using your M4 parameters in Part 4b, check the performance of each of the nine (9) test types with the accepted boundaries. As in M3, you will need to adjust the acceleration start time to be five (5) seconds. Using the results, determine if you have evidence that the ACC system performs the way with the new tires as it did with the old tires. Indicate in each row of Table 4c.1 which tests you believe to be within the performance boundaries and which are not.

Part 5. Algorithm Performance Discussion

Now that you have seen how your algorithm performs, provide an honest assessment. Challenge yourself to find weaknesses within your algorithm. Use your figures, numeric results, benchmark data and experimental data to guide you.

→ *Do you believe your algorithm accurately reflects the true performance of the system? Why or why not?*

→ *Does your algorithm need more work that you are unable to complete because of the due date? If yes, describe what you would do. If no, justify why your analysis is complete as-is.*

→ *Does your technical brief reflect your critique of your algorithm's performance? Remember, it is vital in engineering to accurately represent your work.*

Complete your reflection in Part 5 of the M4 Answer Sheet. Justify your answers using references to your work, data provided, and external sources (if relevant). Use professional written language. Document external references in Part 8 of the M4 Answer Sheet.

Part 6. Technical Brief

As a team, you will write your technical brief. You may find the M4 Client Memo and the original M0 Client Memo helpful when composing your technical brief.

Formatting the Brief

Use the provided template *M4_TechnicalBrief_template.docx* and save your final brief as *M4_TechnicalBrief_SSS_TT.pdf*. Failure to follow the format provided in the template document will result in a loss of points. Your brief must be no longer than two (2) pages, although graphs and/or tables showing results may be included on a third page. List all external references used in the References portion of the template.

Introduction

Address the following in the introduction of your technical brief:

1. In your own words, describe the problem posed by CruiseAuto in 2-3 sentences. This problem should include your team's consensus on what CruiseAuto needs in terms of the deliverable, its function (what the deliverable must be able to do), the criteria for success (indicators used to determine performance), and any constraints (what was provided to guide the development of your solution).

2. Provide an overarching description of your algorithm in 1-2 sentences. This description should emphasize the key features included in the algorithm. Be specific.

3. Summarize three critical decisions your team made to improve the accuracy of the parameter identification during the development of your algorithm. For each decision, provide a clear description, evidence-based rationale(s) for decision, and a discussion of how the accuracy of your model was enhanced based on the decision.

Parameter Identification Procedure

Describe the steps of your algorithm in plain clear English. Be sure to address how you handled the various data sets and errors. Provide sample calculations and equation-based explanations ONLY for steps that may be more difficult to understand or replicate. Avoid complicated sentence structures and references to MATLAB or MATLAB code.

Results

Present results of applying the algorithm to the specified datasets clearly and concisely. This should also include a discussion on the error of your model. Each figure and table of results must be explained in the text (e.g. Figure 1 shows…). Properly manage units and decimal places in figures and tables.

Interpretation

In no more than 3 paragraphs, address the questions of primary interest to CruiseAuto:

- *How can you explain the error in this process? Comment on the quality of the experiments themselves and on your parameter identification algorithm. Use evidence to support your case, including specific data from your analysis and outside references as appropriate.*

- *What can CruiseAuto honestly tell our auto manufacturing partner about the performance of the adaptive cruise control system at this time?*

- *What next steps would you propose for your algorithm if you had more time to complete your analysis?*

Appendix: Figures and Tables

CruiseAuto requested two specific figures and a table (see M4 Client Memo), but you may need to consider additional figures and tables to describe your decisions, results, and interpretation of results completely and concisely. Format all results for technical presentation. Number figures and tables in their title (Figure # and Table #). Refer to figures and tables in the text by number (e.g. Figure 1 shows… Table 1 shows…). Number the figures and tables in the order you talk about them in the brief; place them in the same order in the Appendix. Place figure captions below figures; place table titles above tables. Properly manage units and decimal places in figures and tables.

Part 7. Resumé Insert

In response to the opportunity presented by the CruiseAuto project, create a template for an insert for your resumé. You only need one template for the team (individual team members may refine the insert for their own resumés). The insert should have a header and specific language to describe your project (in 3-5 bulleted statements). In these bulleted statements, try to answer the questions *"What did you do?"*, *"How did you do it?"*, and *"What was your result?"*. The specific language should be "action" oriented and highlight both the project and your contributions to it. Your project title should be something that describes the context of this particular project. Use professional written language. Fill in the template provided in Part 7.

Example

DESIGN PROJECTS

Autonomous Lawn Mower, Purdue University   Spring 2020

- Improved sensor technology resulting in increased safety and reduced cost
- Developed MATLAB code to optimize sensor performance and to perform constraint analysis
- Constructed and tested a functional prototype that surpassed industry standards

Things to Keep in Mind

→ Headers should stand out (Bold/Underlined/Larger Font and/or Capitalized).

→ Do not use "Engineering 132" or "ENGR 132" Project as the project title. Prospective employers will not know what that title means. Give the project a descriptive name.

→ Separate the location and the date of the project. Placing the date on the right side of the page is common, but not required.

→ Your 3-5 bulleted statements should all maintain the same tense (past if previously completed, or present if currently working on).

→ Begin each bullet with a different power verb.

Submitting your Deliverables to Gradescope

Once you have completed each of the parts above, you will submit all of your deliverables to the associated Gradescope assignment.

Submitting to the Individual Assignment (M4 – Individual)

Log onto Gradescope and submit your assigned function(s) for your programming role. Each team member is responsible for submitting their own subfunction(s) to this assignment.

Submitting to the Team Assignment (M4 – Team)

1. Save the answer sheet as a PDF named M4_AnswerSheet_SSS_TT.pdf where SSS is your section number (e.g., 001 for section 001) and TT is your team number (e.g., 07 for team 7).
2. Select one person to submit all files for the team. They should log into Gradescope and submit all these files together to the M4 assignment:
     - → M4_AnswerSheet_SSS_TT.pdf
     - → M4_TechnicalBrief_SSS_TT.pdf
     - → M4_main_SSS_TT_login.m
     - → M4_sub2_SSS_TT_login.m
     - → M4_sub3_SSS_TT_login.m
     - → M4_sub4_SSS_TT_login.m
     - → M4_performance_SSS_TT.m
     - → Any additional UDFs created.
3. Select all team members for the group assignment. [Help Link].
     a. Each team member should confirm that they are part of the submission. Everyone received an email when they were added. You will lose points if you do not include all teammates in the submission.
4. You will see "Autograder" information when you view your submission. Select "Code" in the upper right. That will show all your submission files. The autograder feature is not enabled for this project.
5. After submission, distribute the submitted files to all team members. Ensure all members of the team have copies of the submitted files.

It is important to note that if you need to resubmit anything for any reason, you must resubmit <u>ALL</u> files for the assignment. Gradescope will allow for multiple submissions up until the due date. The person who originally submitted should be the one to resubmit. If someone else resubmits, it can create issues where not everyone is tagged in the assignment and you will lose points.