



AI First Engineering

FUNDAMENTALS OF AI-AUGMENTED ENGINEERING

Chapter 2 / Lab-2 Lab Extension Challenge Report

How Sensitive Is Safe Speed to Reaction Time?

LAB EXTENSION CHALLENGE — INDIVIDUAL SUBMISSION

Individual submission: The main Chapter 2 / Lab-2 laboratory is performed collaboratively. This Extension Challenge is completed and submitted individually so that every student independently practices the computational, AI-assisted, and engineering-judgment skills developed during the team lab.

You may discuss concepts with classmates and may use an AI teammate as directed in the assignment, but you must independently run the parameter study with your own validated Lab-2 functions, produce the table and plot, evaluate the evidence and the AI explanation, and make your own engineering judgment.

You may begin this challenge during the laboratory period or complete it outside the laboratory. Suggested Assessment: **10 points** (rubric on the last page).

Student Information

Student name	
Student ID (if applicable)	
Date	
Lab section (if applicable)	

How to use this template: replace every gray italic guide with your own evidence and reasoning, and delete nothing else. Concise evidence + engineering reasoning beats pages of polished prose. This is a compact challenge — not another full laboratory report. The final section is where you take responsibility for your work.

1. Committed Prediction

RECORDED BEFORE COMPUTATION — DO NOT EDIT AFTERWARD.

If reaction time increases by 20%, I predict maximum safe approach speed will decrease by:

☐ LESS THAN 20% ☐ ABOUT 20% ☐ MORE THAN 20%

My reasoning BEFORE computing:

2. Model + Parameter Study

The same validated Lab-2 model — one parameter changes.

$$d_{stop} = v \cdot t_r + v^2 / (2a)$$

FIXED: $a = 7.0 \text{ m/s}^2$ · $d_{avail} = 50 \text{ m}$ VARIED: t_r (reaction time) → OUTPUT: v_{max}

In the main Lab-2 wet-road study you varied a . Here you hold a fixed and vary t_r . One parameter changes — the validated algorithm stays the same. That is the payoff of functions, parameterization, and reuse.

3. Computational Experiment — Five Reaction-Time Cases

Reuse your validated Lab-2 stopping-distance / search functions. Change ONLY t_r . For each case, determine $v_{\max}$ while keeping $a = 7.0 \text{ m/s}^2$ and $d_{\text{avail}} = 50 \text{ m}$ fixed. Do not ask AI to compute this table for you.

Reaction-time case	t_r [s]	$v_{\max}$ [m/s]	$v_{\max}$ [km/h]
Your ruler-measured representative t_r *			
Simple-reaction reference	0.20		
Intermediate response case	0.50		
Lecture driving-response reference	1.00		
Extended-response case	1.50		

* If your measured $t_r \approx 0.20 \text{ s}$, use $t_r = 0.25 \text{ s}$ instead — do not repeat essentially the same case.

4. One Plot — $v_{\max}$ versus t_r

ONE plot. Horizontal axis: Reaction time, t_r [s]. Vertical axis: Maximum safe speed, $v_{\max}$ [m/s]. Five points are enough to show the shape.



Caption: (what does the figure show, in one sentence?)

5. Test the 20% Prediction

A targeted prediction test — not an additional case for the plot. Reuse your 1.00 s result above, then run one additional case at 1.20 s.

At $t_r = 1.00 \text{ s}$: $v_{\max} = \underline{\hspace{2cm}} \text{ m/s}$ At $t_r = 1.20 \text{ s}$: $v_{\max} = \underline{\hspace{2cm}} \text{ m/s}$

Reaction time increased by: 20 % Safe speed changed by: $\underline{\hspace{2cm}} \%$

My original prediction was: SUPPORTED / NOT SUPPORTED

6. What Does the Evidence Say?

Is $v_{\max}$ proportional to t_r ? YES / NO

Does a 20% increase in t_r cause a 20% decrease in $v_{\max}$? YES / NO

What trend does your plot show?

One physical explanation — why is the relationship not simply proportional? Look at the two terms of $d_{\text{stop}} = v \cdot t_r + v^2/(2a)$: which one cares about t_r , and which one does not?

7. AI Teammate — Explain, Don't Compute

AI is used *AFTER* you have computed and interpreted the results. Give any capable AI assistant (your coding companion) the following prompt:

"I varied reaction time in the stopping-distance model $d_{\text{stop}} = v \cdot t_r + v^2/(2a)$ while holding a and d_{avail} fixed. My computed results are: [paste your compact results]. Explain physically why maximum safe speed does not change in direct proportion to reaction time. Do not recompute my table. Do not change my model."

AI's main explanation (concise summary — not the whole conversation):

8. Human Evaluation of AI

AI explanation verdict: ☐ ACCEPT ☐ MODIFY ☐ REJECT

Why?

If MODIFY — what would you change?

Critical evaluation does not require disagreement — a correct AI explanation may be ACCEPTED after you verify it.

9. Independent Validation

Check ONE reaction-time case without the search — no derivation required.

$$v_{\text{exact}} = a \cdot (-t_r + \sqrt{t_r^2 + 2 \cdot d_{\text{avail}} / a})$$

Selected t_r = _____ s Search result: v_{max} = _____ m/s

Analytical: v_{exact} = _____ m/s Difference: _____ m/s

Do they agree within the expected search resolution (one step)? YES / NO

What does this check support?

10. ENGINEERING JUDGMENT — What Would You Defend?

In 3–5 sentences: (1) What does increasing reaction time do to maximum safe approach speed? (2) Why is the relationship not directly proportional? (3) What does the gap between your ruler-measured case and the 1.00 s lecture driving-response reference tell you about using ruler reaction time as a driver-response model input?

Same functions → new parameter → defended insight — that is what decomposition buys

11. Suggested Assessment Rubric — 10 Points

Criterion	Points
Committed prediction (recorded before computation)	1
Computation — five-case table + plot	3
Trend interpretation + the 20% test	2
AI explanation + ACCEPT / MODIFY / REJECT verdict	2
Independent analytical validation	1
Engineering judgment (incl. the ruler-t_r modeling assumption)	1
TOTAL	10

12. Human Review & Approval

“I reviewed the computations, plot, AI contribution, analytical check, and engineering conclusion in this extension. I accept responsibility for the submitted engineering work.”

Human reviewed and approved.

Would you confidently put your name on this result? Sign only when the answer is yes.

Student name · Signature · Date

AI assists. Humans verify. Humans decide. Humans approve.