
MC3113 Line-Follower Complete Demo Project - Instructor Guide

Version: AY25.1

Branch: demo-instructor-complete

Status: Instructor-only / Do not distribute

Purpose

This complete demo project demonstrates the full MBSE workflow: - Item Definition → Requirements → Architecture/ICD → Controller Design → V&V → Reviews

Use this to: - Show students what “complete” looks like during lectures - Calibrate your rubrics for PDR/CDR/demo marking - Demo live during Lectures 6-9 - Prepare teaching examples

Never share code, models, or editable files with students.

What's Included

Documentation

- [Requirements_Complete.md](#) - 7 requirements (FR + NFR)
- [RTM_Complete.xlsx](#) - Requirements-to-Test Matrix
- [ICD_v1.0.md](#) - Full interface control document
- [SysML_Models.md](#) - BDD and IBD descriptions

Code & Models

- [src/instructor_controller.m](#) - Working P+I controller with S3 safety
- [models/plant_model.slx](#) - Complete Simulink plant (if available)
- [scripts/run_all_scenarios_demo.m](#) - Batch runner

Evidence

- `logs/Demo_S1_final.csv` - S1 nominal run
 - `logs/Demo_S2_final.csv` - S2 obstacle run
 - `logs/Demo_S3_final.csv` - S3 fault run
 - `metrics/Demo_metrics_summary.json` - All metrics
 - `plots/Demo_*.png` - Key plots (e_line, u_L/u_R, v)
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How to Use in Teaching

Lecture 6 (ICD + First S1 Run)

- Show `ICD_v1.0.md` on screen
- Run S1 live: `run_scenario('S1', @instructor_controller, 'Live_S1')`
- Open generated log, show columns match ICD
- Compute metrics live

Lecture 7 (Standards → Safety Requirements)

- Show `Requirements_Complete.md` R-CAP and R-LL
- Explain how ISO 26262 safe-state concept led to these
- Show S3 log section where `fault_flag=1` and $v \leq 0.45$

Lecture 8-9 (PDR Preparation)

- Display RTM table and trace one requirement end-to-end
- Show S1 plots: `Demo_e_line.png`, `Demo_commands.png`
- Discuss trade-offs: IAE vs energy vs time

Week 11 (CDR Readiness)

- Show all three scenarios' metrics side-by-side
 - Highlight where safety requirements passed/failed
 - Use as calibration: "This is B+/A- quality work"
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Running the Demo Controller

```
1 cd '/path/to/LineFollowerDemo'
2 git checkout demo-instructor-complete
3
4 addpath('src', 'scripts', 'metrics', 'demo-solution');
5
6 % Run all three scenarios
7 run_all_scenarios_demo();
8
9 % Or run individually
10 run_scenario('S1', @instructor_controller, 'Demo_S1_final');
11 run_scenario('S2', @instructor_controller, 'Demo_S2_final');
12 run_scenario('S3', @instructor_controller, 'Demo_S3_final');
13
14 % Compute metrics
15 m1 = compute_metrics('logs/Demo_S1_final.csv', 'S1');
16 m2 = compute_metrics('logs/Demo_S2_final.csv', 'S2');
17 m3 = compute_metrics('logs/Demo_S3_final.csv', 'S3');
```

Key Teaching Points

What to Emphasize

- **Traceability:** Every requirement has TestID, scenario, evidence
- **ICD as contract:** Controller respects signal ranges/units
- **Safety first:** S3 metrics show hard constraints (speed cap, line-loss)
- **Iteration:** Mention this took 3-4 design cycles to tune

What NOT to Say

- “This is the optimal solution” (it’s deliberately mid-range)
- “Copy this structure exactly” (encourage variety in RTM/SysML formats)
- Avoid showing exact gain values (Kp, Ki) before PDR

Maintenance

- **After each semester:** Review metrics thresholds if scenarios change

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- **If plant model updates:** Re-run all scenarios, regenerate logs
 - **Keep separate from main branch:** Never merge demo-solution/ into main
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End of Instructor Guide