

2025-11-01

14-Day Full Immersion

Daily Checklist

DIP-SMC-PSO Project

Print this document and check off items as you complete them.

Each day is designed for 8-10 hours of focused learning.

Total Time: 112-140 hours

Goal: 70-85% project understanding

Materials: 30 podcasts, 30 cheatsheets, 6 controllers

Generated: February 11, 2026

Contents

| | | |
|----------|---|-----------|
| 0 | WEEK 1: THEORY + ARCHITECTURE | 2 |
| 0.0 | Day 1: Project Foundations [___ / 8 hours] | 2 |
| 0.0 | Day 2: Plant Dynamics [___ / 10 hours] | 3 |
| 0.0 | Day 3: Optimization Fundamentals [___ / 9 hours] | 4 |
| 0.0 | Day 4: Simulation Engine [___ / 10 hours] | 5 |
| 0.0 | Day 5: Controllers Part 1 [___ / 10 hours] | 6 |
| 0.0 | Day 6: Controllers Part 2 [___ / 10 hours] | 7 |
| 0.0 | Day 7: Analysis & Visualization [___ / 9 hours] | 8 |
| 0 | WEEK 2: PRACTICE + INTEGRATION | 9 |
| 0.0 | Day 8: Testing & Quality [___ / 10 hours] | 9 |
| 0.0 | Day 9: Research Outputs [___ / 9 hours] | 10 |
| 0.0 | Day 10: Systems Integration [___ / 10 hours] | 11 |
| 0.0 | Day 11: Professional Standards [___ / 8 hours] | 12 |
| 0.0 | Day 12: Configuration & Deployment [___ / 10 hours] | 13 |
| 0.0 | Day 13: Documentation & MCP [___ / 9 hours] | 14 |
| 0.0 | Day 14: Capstone Project [___ / 10 hours] | 15 |
| | Completion Certificate | 16 |
| | Next Steps After Completion | 16 |

section **WEEK 1: THEORY + ARCHITECTURE**

subsection **Day 1: Project Foundations** [--- / 8 hours]**Date:** _____**Actual Hours:** _____**Morning Block (4 hours)**

- ☐ Hour 1-2: Listen to E001 podcast (18 min)
- ☐ Hour 1-2: Read E001 cheatsheet PDF
- ☐ Hour 3-4: Listen to E002 podcast (18 min)
- ☐ Hour 3-4: Read E002 cheatsheet PDF

Afternoon Block (4 hours)

- ☐ Hour 5-6: Read `.ai_workspace/guides/session_continuity.md`
- ☐ Hour 5-6: Read `CLAUDE.md` (project conventions)
- ☐ Hour 7: Setup environment: Clone repo if needed
- ☐ Hour 7: Install dependencies: `pip install -r requirements.txt`
- ☐ Hour 8: Run first simulation: `python simulate.py --ctrl classical_smc --plot`
- ☐ Hour 8: Verify Streamlit works: `streamlit run streamlit_app.py`

Evening Reflection

- ☐ Write 3-5 sentences: What did I learn today?
- ☐ Preview Day 2 materials
- ☐ Rate understanding: 1-10 _____

Notes:

subsection **Day 2: Plant Dynamics** [___ / 10 hours]

Date: _____

Actual Hours: _____

Morning Block (4 hours)

- ☐ Hour 1-2: Listen to E003 podcast
- ☐ Hour 1-2: Read E003 cheatsheet PDF
- ☐ Hour 3-4: Code walkthrough: `src/plant/models/simplified_dynamics.py`
- ☐ Hour 3-4: Code walkthrough: `src/plant/models/full_nonlinear_dynamics.py`

Afternoon Block (4 hours)

- ☐ Hour 5: Study low-rank dynamics variant
- ☐ Hour 6-7: Read `docs/theory/plant-dynamics.md`
- ☐ Hour 8: Visualize pendulum physics (double pendulum animations)

Evening Block (2 hours)

- ☐ Hour 9: Open `config.yaml`, find plant parameters section
- ☐ Hour 9: Modify mass values (m_1 , m_2), observe simulation behavior
- ☐ Hour 10: Modify length values (l_1 , l_2), observe stability changes

Evening Reflection

- ☐ Write 3-5 sentences: What did I learn today?
- ☐ Preview Day 3 materials
- ☐ Rate understanding: 1-10 _____

Notes:

subsection **Day 3: Optimization Fundamentals** [___ / 9 hours]

Date: _____

Actual Hours: _____

Morning Block (4 hours)

- ☐ Hour 1-2: Listen to E004 podcast (26 min)
- ☐ Hour 1-2: Read E004 cheatsheet PDF
- ☐ Hour 3-5: Code walkthrough: `src/optimizer/pso_optimizer.py` (413 lines)
- ☐ Hour 3-5: Understand PSO parameters: swarm size, iterations, bounds

Afternoon Block (3 hours)

- ☐ Hour 6-7: Read research paper excerpts on PSO theory
- ☐ Hour 6-7: Study `academic/paper/experiments/` structure

Evening Block (2 hours)

- ☐ Hour 8: Run PSO optimization
- ☐ Hour 9: Analyze results: Compare tuned vs. default gains
- ☐ Hour 9: Visualize convergence plots

Evening Reflection

- ☐ Write 3-5 sentences: What did I learn today?
- ☐ Preview Day 4 materials
- ☐ Rate understanding: 1-10 _____

Notes:

subsection **Day 4: Simulation Engine** [___ / 10 hours]

Date: _____

Actual Hours: _____

Morning Block (4 hours)

- ☐ Hour 1-2: Listen to E005 podcast (26 min)
- ☐ Hour 1-2: Read E005 cheatsheet PDF
- ☐ Hour 3-5: Code walkthrough: `src/core/simulation_runner.py`
- ☐ Hour 3-5: Code walkthrough: `src/core/simulation_context.py`

Afternoon Block (4 hours)

- ☐ Hour 6: Study integrators: RK45, Euler, custom methods
- ☐ Hour 7: Understand vectorized simulation in `src/core/vector_sim.py`
- ☐ Hour 8: Study Numba optimizations and performance

Evening Block (2 hours)

- ☐ Hour 9: Run batch simulations with different integrators
- ☐ Hour 10: Compare accuracy and speed tradeoffs
- ☐ Hour 10: Document findings in personal notes

Evening Reflection

- ☐ Write 3-5 sentences: What did I learn today?
- ☐ Preview Day 5 materials
- ☐ Rate understanding: 1-10 _____

Notes:

subsection **Day 5: Controllers Part 1** [___ / 10 hours]

Date: _____

Actual Hours: _____

Morning Block (4 hours)

- ☐ Hour 1-2: Read E030 cheatsheet PDF (Controller Base & Factory)
- ☐ Hour 3-5: Code deep-dive: `src/controllers/base/base_controller.py`
- ☐ Hour 3-5: Code deep-dive: `src/controllers/factory/controller_factory.py`

Afternoon Block (4 hours)

- ☐ Hour 6-8: Classical SMC implementation study
- ☐ Hour 6-8: File: `src/controllers/smc/algorithms/classical_smc.py` (538 lines)
- ☐ Hour 6-8: Understand sliding surface, reaching law, control law

Evening Block (2 hours)

- ☐ Hour 9-10: Hands-on: Implement sliding surface equation from scratch
- ☐ Hour 9-10: Verify your implementation against production code
- ☐ Hour 9-10: Test with simple pendulum case

Evening Reflection

- ☐ Write 3-5 sentences: What did I learn today?
- ☐ Preview Day 6 materials
- ☐ Rate understanding: 1-10 _____

Notes:

subsection **Day 6: Controllers Part 2** [___ / 10 hours]

Date: _____

Actual Hours: _____

Morning Block (4 hours)

- ☐ Hour 1-3: Super-Twisting SMC deep-dive
- ☐ Hour 1-3: File: `src/controllers/smc/algorithms/super_twisting_smc.py` (592 lines)
- ☐ Hour 1-3: Understand chattering reduction mechanism

Afternoon Block (4 hours)

- ☐ Hour 4-6: Adaptive SMC study
- ☐ Hour 4-6: File: `src/controllers/smc/algorithms/adaptive_smc.py` (473 lines)
- ☐ Hour 4-6: Understand gain adaptation rules

Evening Block (2 hours)

- ☐ Hour 7-9: Hybrid Adaptive STA-SMC
- ☐ Hour 7-9: File: `src/controllers/smc/algorithms/hybrid_adaptive_sta_smc.py` (277 lines)
- ☐ Hour 10: Compare chattering behavior across all 4 controllers
- ☐ Hour 10: Run simulations with each controller, measure chattering index

Evening Reflection

- ☐ Write 3-5 sentences: What did I learn today?
- ☐ Preview Day 7 materials
- ☐ Rate understanding: 1-10 _____

Notes:

subsection **Day 7: Analysis & Visualization** [___ / 9 hours]

Date: _____

Actual Hours: _____

Morning Block (4 hours)

- ☐ Hour 1-2: Listen to E006 podcast (28 min - LONGEST)
- ☐ Hour 1-2: Read E006 cheatsheet PDF
- ☐ Hour 3-5: Code walkthrough: `src/analysis/` directory
- ☐ Hour 3-5: Code walkthrough: `src/utils/visualization/` directory

Afternoon Block (3 hours)

- ☐ Hour 6-7: Study benchmark framework: `src/benchmarks/`
- ☐ Hour 6-7: Review `benchmarks/figures/` - publication-quality examples

Evening Block (2 hours)

- ☐ Hour 8: Generate plots: State trajectories, control effort, chattering
- ☐ Hour 9: Calculate chattering metrics for all controllers
- ☐ Hour 9: Create comparison table

Evening Reflection

- ☐ Write 3-5 sentences: What did I learn this week?
- ☐ Review Week 1 progress: What % do I understand? _____
- ☐ Preview Day 8 materials
- ☐ Rate overall Week 1: 1-10 _____

Notes:

section **WEEK 2: PRACTICE + INTEGRATION**

subsection **Day 8: Testing & Quality** [--- / 10 hours]**Date:** _____**Actual Hours:** _____**Morning Block (4 hours)**

- ☐ Hour 1-2: Listen to E007 podcast
- ☐ Hour 1-2: Read E007 cheatsheet PDF
- ☐ Hour 3-5: Explore `tests/test_controllers/` directory
- ☐ Hour 3-5: Study test patterns for all 6 controllers

Afternoon Block (4 hours)

- ☐ Hour 6-7: Read `.ai_workspace/config/testing_standards.md`
- ☐ Hour 6-7: Understand coverage requirements (85%/95%/100%)

Evening Block (2 hours)

- ☐ Hour 8: Run pytest suite: `python -m pytest tests/test_controllers/ -v`
- ☐ Hour 9: Write test for custom controller variant
- ☐ Hour 10: Generate coverage report: `python -m pytest --cov=src --cov-report=html`
- ☐ Hour 10: Review coverage in `htmlcov/index.html`

Evening Reflection

- ☐ Write 3-5 sentences: What did I learn today?
- ☐ Preview Day 9 materials
- ☐ Rate understanding: 1-10 _____

Notes:

subsection **Day 9: Research Outputs** [___ / 9 hours]

Date: _____ — **Actual Hours:** _____

Key Activities

- ☐ Listen to E008 podcast (27 min) + Read E008 cheatsheet PDF
- ☐ Read LT-7 research paper (submission-ready version)
- ☐ Study `academic/paper/experiments/comparative/` directory
- ☐ Analyze MT-5, MT-7, MT-8 benchmark results
- ☐ Compare personal Day 3 PSO results with published benchmarks

Understanding Rating: 1-10 _____

Notes:

subsection **Day 10: Systems Integration** [___ / 10 hours]

Date: _____ — **Actual Hours:** _____

Key Activities

- ☐ Listen to E012 + E013 podcasts (HIL, Monitoring)
- ☐ Code walkthrough: `src/hil/plant_server.py`, `src/hil/controller_client.py`
- ☐ Study monitoring infrastructure: `src/utls/monitoring/`
- ☐ Run HIL simulation: `python simulate.py --run-hil --plot`
- ☐ Visualize real-time monitoring data
- ☐ Analyze control loop timing statistics

Understanding Rating: 1-10 _____

Notes:

subsection **Day 11: Professional Standards** [___ / 8 hours]

Date: _____ — **Actual Hours:** _____

Key Activities

- ☐ Read E015-E019 cheatsheets (Architecture, Memory, Workspace)
- ☐ Study `.ai_workspace/guides/architectural_standards.md`
- ☐ Review `.ai_workspace/guides/controller_memory.md`
- ☐ Read E020 cheatsheet (Git workflow)
- ☐ Practice git operations: branch, commit, merge

Understanding Rating: 1-10 _____

Notes:

subsection **Day 12: Configuration & Deployment** [___ / 10 hours]

Date: _____ — **Actual Hours:** _____

Key Activities

- ☐ Listen to E011 podcast + Read E011 cheatsheet PDF
- ☐ Deep-dive into `config.yaml` - ALL sections
- ☐ Study Pydantic validation: `src/config/` directory
- ☐ Create custom config: `capstone.config.yaml`
- ☐ Test config validation with intentional errors
- ☐ Run simulation with custom config

Understanding Rating: 1-10 _____

Notes:

subsection **Day 13: Documentation & MCP** [___ / 9 hours]

Date: _____ — **Actual Hours:** _____

Key Activities

- ☐ Listen to E009 + E010 podcasts (Educational Materials, Documentation)
- ☐ Navigate complete docs using `docs/NAVIGATION.md`
- ☐ Study `.ai_workspace/guides/mcp_usage_guide.md`
- ☐ Build Sphinx documentation: `sphinx-build -M html docs docs/_build`
- ☐ Explore MCP servers: sequential-thinking, pytest-mcp, filesystem, sqlite-mcp

Understanding Rating: 1-10 _____

Notes:

subsection **Day 14: Capstone Project** [___ / 10 hours]

Date: _____ — **Actual Hours:** _____

Morning Block (2 hours)

- ☐ Hour 1-2: Listen to E021 podcast + Read E024 cheatsheet

CAPSTONE EXERCISE (8 hours)

Phase 1: Design (1 hour)

- ☐ Hour 3: Define research question
- ☐ Hour 3: Plan experiment methodology
- ☐ Hour 3: Document expected outcomes

Phase 2: Configuration (1 hour)

- ☐ Hour 4: Create custom `capstone.config.yaml`
- ☐ Hour 4: Select 2 controllers to compare
- ☐ Hour 4: Configure noise levels, simulation duration

Phase 3: Optimization (2 hours)

- ☐ Hour 5-6: Run PSO optimization for Controller 1
- ☐ Hour 5-6: Run PSO optimization for Controller 2
- ☐ Hour 5-6: Save gains to JSON files

Phase 4: Benchmark (2 hours)

- ☐ Hour 7: Execute comparative benchmark
- ☐ Hour 7: Run 20 Monte Carlo trials per controller
- ☐ Hour 8: Calculate statistics: mean, std, confidence intervals
- ☐ Hour 8: Measure chattering index, settling time, tracking error

Phase 5: Analysis (1 hour)

- ☐ Hour 9: Generate plots: state trajectories, control effort, chattering
- ☐ Hour 9: Create comparison table
- ☐ Hour 9: Statistical significance testing (t-test)

Phase 6: Documentation (1 hour)

- ☐ Hour 10: Write markdown report (`capstone_report.md`)
- ☐ Hour 10: Include: research question, methodology, results, conclusions
- ☐ Hour 10: Commit work using proper git workflow
- ☐ Hour 10: Push to repository (if applicable)

COMPLETION CERTIFICATE

I, _____, completed the 14-Day Full Immersion DIP-SMC-PSO Learning Program.

Start Date: _____

End Date: _____

Total Hours: _____

Achievements:

- ☐ Understand all 6 controller algorithms
- ☐ Can run and modify simulations independently
- ☐ Completed PSO optimization successfully
- ☐ Generated publication-quality plots
- ☐ Completed capstone project
- ☐ Ready to contribute code to the project

Signature: _____ **Date:** _____

Next Steps After Completion

enumiBegin Tutorial 01: `docs/guides/getting-started.md`

- 0. enumiContinue 1-2 hours/day for 2-3 months (reach mastery)
- 0. enumiUse podcasts during commute for reinforcement
- 0. enumiJoin research tasks: `.ai_workspace/planning/research/`
- 0. enumiContribute to open issues or propose new features
- 0. enumiConsider publishing your capstone findings

Target Mastery Date: _____