

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

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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/smoothed_mpc/algorithms/classical_smoothed_mpc.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/utils/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: _____