2025-11-01

# E014: Development Infrastructure

DIP-SMC-PSO Educational Series

January 25, 2026

## Overview

This episode covers development infrastructure from the DIP-SMC-PSO project.

**Part:** Part3 Advanced
**Duration:** 15-20 minutes
**Source:** Comprehensive Presentation Materials

## section0 Educational System Overview

**Mission:** Democratize access to advanced control theory
44 episodes covering Phases 1-4, 40 hours audio content
Convert written materials to commute-friendly learning format

## section0 Beginner Roadmap: Path 0

**Target:** Zero prerequisites (no coding/control theory background)
**Duration:** 125-150 hours over 4-6 months
**Phase Breakdown:**
- **Computing Fundamentals (30 hrs)**
- Terminal/command line basics - Git version control - Package management (pip, conda)
- **Python Programming (40 hrs)**
- Variables, functions, classes - NumPy/SciPy fundamentals - Matplotlib visualization
- **Physics & Mathematics (35 hrs)**
- Classical mechanics (pendulum dynamics) - Linear algebra (matrices, eigenvalues) - Differential equations (ODEs)
- **Control Theory (20 hrs)**
- PID control introduction - State-space representation - Lyapunov stability basics

## section0 Tutorial System Architecture

**Progressive Learning Structure:**

| **Tutorial** | **Topic** | **Duration** |
|---|---|---|
| Tutorial 01 | Getting Started<br>CLI basics, first simulation | 1-2 hrs |
| Tutorial 02 | Controller Comparison<br>All 7 controllers, PSO tuning | 3-4 hrs |
| Tutorial 03 | Advanced Features<br>Batch simulation, monitoring | 4-5 hrs |
| Tutorial 04 | Web Interface<br>Streamlit dashboard, real-time plots | 2-3 hrs |
| Tutorial 05 | Research Workflow<br>Reproducible experiments, paper figures | 5-8 hrs |

Every tutorial includes runnable code, expected outputs, troubleshooting tips

## section0 NotebookLM Podcast Series

**Innovation:** Convert documentation to podcast-style audio
**Series Statistics:**
- **44 episodes** covering Phases 1-4 - ** 40 hours** total audio content - **125 hours** equivalent learning material - TTS optimization for commute/exercise listening
**Episode Structure:**
- **Phase 1:** Foundations (Python, Git, Physics) – 12 episodes - **Phase 2:** Control Theory (SMC, PSO) – 10 episodes - **Phase 3:** Implementation (Controllers, Simulation) – 14 episodes - **Phase 4:** Advanced Topics (HIL, Monitoring, Research) – 8 episodes
Episode templates, TTS optimization checklist, phase-specific examples
*See:* '.ai_workspace/guides/notebooklm_guide.md'

## section0 Learning Path Integration

**Seamless Progression Across Paths:**
[Visual diagram - see PDF]

## Resources

- **Repository:** `https://github.com/theSadeQ/dip-smc-pso.git`
- **Documentation:** See `docs/` directory
- **Getting Started:** `docs/guides/getting-started.md`

*Educational podcast episode generated from comprehensive presentation materials*