TwinOps

Digital Twins Meet DevOps

Introduction
Cyber-Physical Systems (CPS) exhibit multiple engineering, verification and validation (V&V), and testing challenges. In this project, we aimed at reducing the time to get first test results by leveraging state-of-the-art system and software engineering approaches.

TwinOps explored the interplay between three core technologies:

- *Model-Based Engineering (MBE)*: model-based engineering relies on models as first-class abstraction of a system to support engineering activities;
- *DevOps:* an organizational effort to support continuous delivery of software through a better coupling between (Dev)elopment and (Op)erations activities;
- *Digital Twins*: an infrastructure to support system monitoring and diagnosis in real-time and enable continuous system improvement.

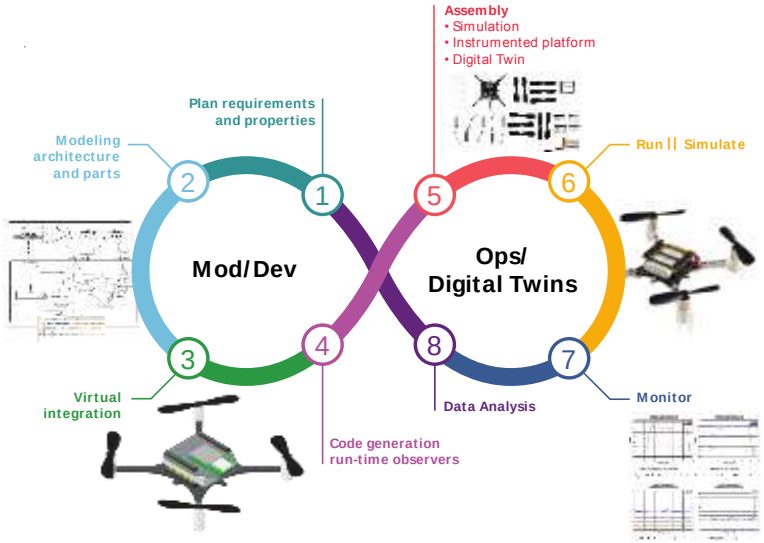
Achievements
SEI delivers a ModDevOps exemplar

> ModDevOps extends DevOps through MBE and its V&V and code generation capabilities. We demonstrate how MBE enables rapid system prototyping through a DevOps cycle.

SEI enhances analysis and testing process for systems architects who build software-intensive CPS with the *TwinOps* process

> TwinOps builds on ModDevOps and Digital Twins to collect data on a system at runtime, and compare it to other engineering artifacts: model simulation and analysis. This comparison enables rapid system diagnosis.

Model-Based Engineering brings early V&V and code generation to DevOps automation, or ModDevOps



Approach
ModDevOps is defined as an abstract process using OMG SysML. This captures the key steps of the process as a collection of use cases, block diagrams, and activities.

⇒ Each project will adapt ModDevOps to its own problem/solution spaces

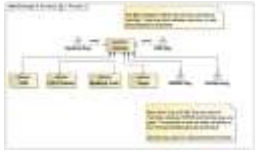
TwinOps is an instance of ModDevOps tailored for CPS. It combines

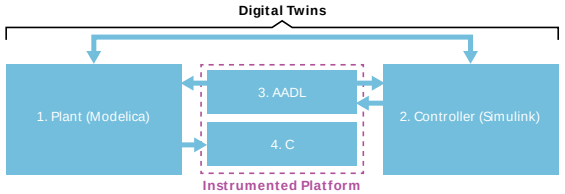
- AADL modeling for CPS architecture
- Simulink or C for the functional code
- Modelica for modeling the environment

The definition of the process as SysML models guides engineering phases:

- Orchestrate modeling, code generation, and compilation
- Continuous integration/continuous deployment used to deploy the system on the target, using Azure IoT cloud-based solutions

Code generation from model enables multiple scenarios: deployment on target and digital twins to support various operating scenarios.





This material is based upon work funded and supported by the Department of Defense under Contract No. FA8702-15-D-0002 with Carnegie Mellon University for the operation of the Software Engineering Institute, a federally funded research and development center.

DM20-0864