SEPOC 2025 - Industrial Challenge with Typhoon HIL

Theme: *Model Based Engineering for advancing the industry*

1. Overview

Integrating advanced control strategies, machine learning (ML) and artificial intelligence (AI) into digital power (i.e. software-aided energy processing systems) has opened new frontiers in system optimization, control, fault detection, and many other fields. As systems become more complex and embedded in critical applications, such as renewable energy, electric mobility, and smart grids, intelligent algorithms and Model-Based Engineering (MBE) offer significant advantages over traditional approaches. Software-driven systems can provide faster response, higher adaptability, and improved accuracy in managing nonlinear, time-varying systems, making them an essential part of modern power electronics and power systems research and design. At the same time, the design and validation of such complex systems become overwhelming if not properly managed

The SEPOC 2025 Industrial Challenge with Typhoon HIL is an international technical competition designed to promote the integration of Model-Based Engineering (MBE) into engineering solutions, using the TyphoonSim simulator.

We invite participants to develop and demonstrate innovative solutions for power electronics, power systems, control systems, and other fields using MBE and all the potential of TyphoonSim.

Key takeaways:

- Participants are invited to form teams of **up to 5 members**.
- Teams can select any topic covered by SEPOC 2025 as their research or application theme in this challenge.
- Authors who are preparing a paper to SEPOC 2025 are encouraged to integrate TyphoonSim in their work and also participate in the Challenge.

2. Objectives and Scope

The Challenge spans all fields in SEPOC 2025's Call for Papers. Teams can select any industrial application topic to explore and propose solutions or use their ongoing research or manuscript as basis. With this, the Challenge aims to:

- Encourage participants to adopt an MBE development approach in association with other computing tools such as AI, leveraging simulation-based techniques for system design and validation in a variety of applications.
- Showcase the full potential of Model-Based Engineering in a unified environment, which can significantly aid in advancing industry by incorporating digital-power analysis.

The main objective is for participants to develop and demonstrate innovative solutions to power electronics and/or power systems problems (e.g., analysis, control, diagnosis, test automation, optimization, etc.) using a model-based engineering approach.

The solution **must**:

- Include a simulation of the electrical/electronic system using TyphoonSim.
- Present applied research that advances digital power applications - including power electronics and/or power systems, with demonstrating clear relevance and applicability to real-world systems.
- Include a demonstration and documentation of the approach.

For extra points the participants may:

- Use **AI or ML techniques** to solve or enhance some aspects of the problem.
- Use TyphoonTest framework and/or TyphoonTest IDE to integrate a Python script for optimization or test automation, further boosting the capabilities of your solution.
- Real-time testing using Typhoon HIL simulators.

3. Eligibility and Team Composition

- **Who can participate:**
  Open to teams of **up to 5 members***, including:
  - Undergraduate and graduate students
  - Young professionals
  - Researchers and enthusiasts
- **Recommended skills:**
  - Knowledge in electrical engineering, power and/or control systems, computation
  - Familiarity with simulation tools
- **Team registration deadline:** July 13th

* At least one member of the team must be registered at the SEPOC 2025 by the beginning of the conference.

4. General Guidelines

1. Teams must use TyphoonSim for testing and validation of their proposal.
2. Teams that seek an AI-based solution are encouraged to use the language or model of their choice for development.
3. The use of other tools is allowed and their integration with TyphoonSim in the MBE approach is encouraged.
4. Each team is free to choose their research/application among the topics covered by SEPOC 2025 Call for Papers.
5. At least one member of your team must complete the Typhoon HIL specialization courses and become a HIL Specialist by the end of the challenge (for eligibility to win the prizes during the Final phase). HIL Specialist is free of charge.
6. Real-time simulation implemented in Typhoon HIL hardware is not mandatory but may also be used and will be evaluated as an extra.
7. The developed solution must be original work, but all Teams are encouraged to expand their report and submit it as a paper for SEPOC 2025.
8. Authors who are preparing a paper for SEPOC 2025 are encouraged to integrate TyphoonSim and AI techniques in their work and also participate in the challenge.
9. All teams are encouraged to use HIL Academy as a resource for studying and preparing their solution.
10. The Challenge last phase consists of a short presentation of the finalists during SEPOC 2025. Preferably, at least one participant of each finalist team should attend in-person, but online live presentations will be possible.

Participants are free to choose or define a **real-world problem** within the SEPOC 2025 topics. Example application areas include:

- Fault detection and predictive maintenance
- AI-assisted control of power converters or motor drives
- Smart energy management in microgrids
- Optimization of electrical systems (e.g., sizing, switching, load balancing)
- Forecasting and classification using electrical signals

5. Deliverables

Each team must submit:

- **White paper** (max 2 pages) in IEEE format (template will be provided)
- **Simulation files** from TyphoonSim
- **Codes, scripts, and any other auxiliary files** used (Python, Julia, MATLAB, etc.)
- **Short video** (max 5 minutes) explaining your solution
- Optional: any supplementary materials your team find relevant to submit

6. Timeline & Phases

Phase	Dates	Description
Registration Opens	June 13	Teams sign up, receive initial documentation and instructions
Submission Deadline	October 3	Submit white paper report, simulation files, code, and 5-min presentation
Evaluation Phase	October 4-20	Panel of experts reviews and scores submissions
Finalists announced	October 23	
Finalist presentations	During SEPOC 2025	Finalists present at the conference, preferably in-person. Awards and recognition follow

7. Evaluation Criteria

Criterion	Weight (%)
Relevance and originality	25%
Technical accuracy and MBE approach	25%
Simulation and validation rigor	25%
Clarity and documentation	15%
Presentation and impact	10%

Bonus points may be awarded for:

- Use **AI or machine learning techniques** to solve or enhance some aspect of the problem
- Integrate test automation using Python scripts to further boost the capabilities of your solution
- Deployment of real-time testing using Typhoon HIL simulators
- Public availability of code or reproducible notebooks

8. Tools and Resources Provided

- TyphoonSim is available for download [in this link]
- Training resources: Documentation, video tutorials, and examples

9. Awards and Recognition

Winners will be announced during the SEPOC 2025 [1].

🥇 **1st Place**: BRL 2.000,00, Certificate, Sponsored Prize (**Typhoon HIL101 simulator [2] and HIL TI Launchpad Interface [2]**)

🥈 **2nd Place**: BRL 1.000,00, Certificate, Sponsored Prize (**Typhoon HIL101 simulator [2]**)

🥉 **3rd Place**: BRL 500,00, Certificate, Honorable Mention

All finalists: Certificate

[1] At least one member of the team must be registered at the SEPOC 2025 by the beginning of the conference.

[2] The real-time simulators and interface boards will be awarded to the academic institution of one of the members of the winning team, to be chosen by the applicants:

- Ex-works delivery terms apply, i.e., all costs and risks, including transport, insurance, customs clearance, and delivery to the final destination are the responsibility of the entity receiving the awarded equipment.
- Fully integrated software toolchain with all toolboxes unlocked and unlimited number of installations for two years. Following the expiration of the initial two-year period, certain additional charges may apply.