SPTG: Symbolic Path-Guided Test Generator

SPTG is a model-based test generation tool that automatically produces **conformance test cases** from system models mixing **data** and **timing constraints**.
It relies on **path-guided symbolic execution**, which follows a selected consecutive sequence of transitions (the **test purpose path**) while collecting symbolic constraints on inputs and timing.

Key Features

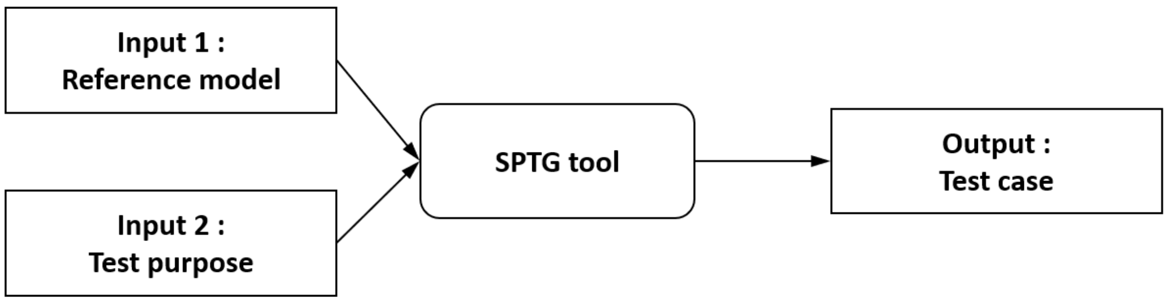
- **Symbolic execution** — Generates test cases along *test purpose paths* by accumulating symbolic constraints on input data and timing conditions.
- **Unified treatment of data, time, and quiescence** — Supports both data and clock variables, and distinguishes between *expected quiescence* (permitted silence within a delay) and *missing outputs* (silence when an output is expected).
- **Deterministic path selection** — Only deterministic paths are used; non-deterministic ones are discarded, ensuring unambiguous, executable test cases that align with the symbolic execution tree.
- **Concise test cases** — Infeasible branches are pruned, and redundant constraints are simplified to keep the test cases minimal.
- **Coverage-oriented testing** — Test purpose paths can be user-defined or automatically selected from reference system model. As an extension of the Diversity symbolic execution platform, SPTG inherits advanced coverage analysis and test selection capabilities.

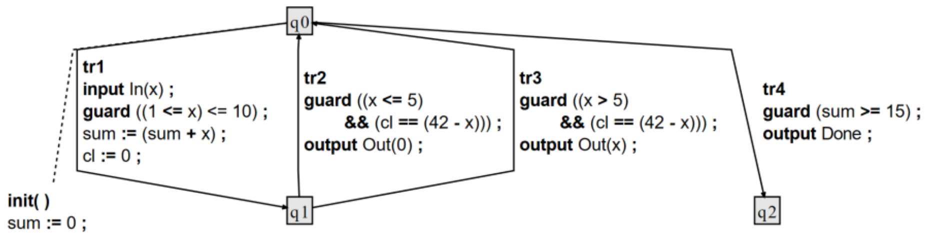
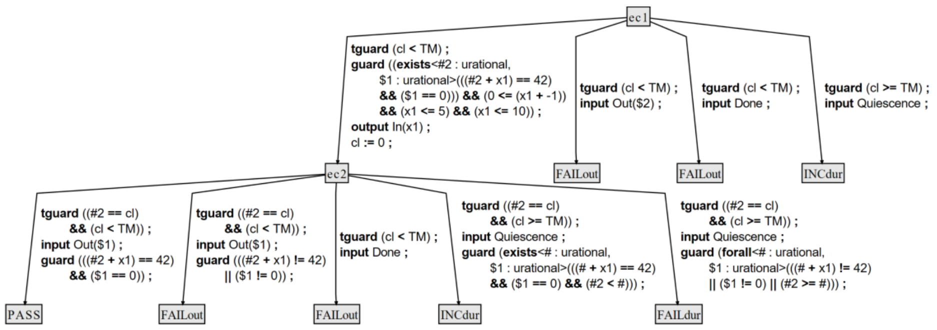
Applications

- **Model-Based Testing (MBT)** of systems with combined data and timing behaviors.
- **Offline generation** of efficient and deterministic test suites from formal models.
- **Teaching and demonstration** of symbolic execution and model-based test generation principles.

SPTG implements the **Symbolic Path-Guided Test Generation** approach described in:
👉 https://doi.org/10.1016/j.scico.2025.103285 *(Open Access)*

SPTG Tool I/O Flow



Description	**Content**
Input 1: *Timed symbolic automaton — Reference system model*	 q0 tr1 input In(x) ; guard ((1 <= x) <= 10) ; sum := (sum + x) ; cl := 0 ; tr2 guard ((x <= 5) && (cl == (42 - x))) ; output Out(0) ; tr3 guard ((x > 5) && (cl == (42 - x))) ; output Out(x) ; tr4 guard (sum >= 15) ; output Done ; init( ) sum := 0 ; q1 q2
Input 2: *Sequence of transitions (path) — Test purpose*	`tr1.tr2`
Output: *Deterministic timed symbolic automaton — Generated test case*	 ec1 tguard (cl < TM) ; guard ((exists<#2 : urational, $1 : urational>(((#2 + x1) == 42) && ($1 == 0))) && (0 <= (x1 + -1)) && (x1 <= 5) && (x1 <= 10)) ; output In(x1) ; cl := 0 ; tguard (cl < TM) ; input Out($2) ; tguard (cl < TM) ; input Done ; tguard (cl >= TM) ; input Quiescence ; ec2 FAILout FAILout INCdur tguard ((#2 == cl) && (cl < TM)) ; input Out($1) ; guard (((#2 + x1) == 42) && ($1 == 0)) ; tguard ((#2 == cl) && (cl < TM)) ; input Out($1) ; guard (((#2 + x1) != 42) || ($1 != 0)) ; tguard (cl < TM) ; input Done ; tguard ((#2 == cl) && (cl >= TM)) ; input Quiescence ; guard (exists<# : urational, $1 : urational>(((# + x1) == 42) && ($1 == 0) && (#2 < #))) ; tguard ((#2 == cl) && (cl >= TM)) ; input Quiescence ; guard (forall<# : urational, $1 : urational>(((# + x1) != 42) || ($1 != 0) || (#2 >= #))) ; PASS FAILout FAILout INCdur FAILdur

Using SPTG

```
./bin/sptg.exe ./examples/example02_dummy/workflow_4_testcase_generation.sew``
```

excerpt of symbolic execution workflow file `./examples/example02_dummy/workflow_4_testcase_generation.sew`

```
project 'location of input reference model' [
    source = "."
    model  = "example02_dummy.xlia"
] // end project
...
path#guided#testcase#generator testcase_genertor {
    trace 'input test purpose' [
        transition = "tr1"
        transition = "tr2"
    ] // end trace
    vfs 'location and name of generated test case' [
        folder = "output"
        file#tc       = "testcase.xlia"
        file#tc#puml  = "testcase.puml"
    ] // end vfs
    ...
}
```

This workflow instructs SPTG to generate a **test case** from the **reference model** (`example02_dummy.xlia`) using the **sequence of transitions** (`tr1`, `tr2`) that define the *test purpose*.

> **Note:**
> The input reference model automaton is encoded in the **XLIA language**, the input language of the **Diversity** symbolic execution platform.
> SPTG extends Diversity with dedicated functionality for symbolic path-guided test generation.
> See model_specification for more details.

SPTG generates the resulting **test case automaton** in both **XLIA** and **PlantUML** formats.
You can convert the `.puml` output to `.svg` using **PlantUML** (see the PlantUML Conversion Guide) or the online tool PlantText.

Tutorials are available on:

- Model specification for SPTG
- Test case generation using SPTG
- Test purpose selection (inherited from the Diversity platform)

📓 See Tutorials

Compilation Instructions

(To be completed with compilation steps)

PlantUML: PUML to SVG Conversion Guide

A quick reference for converting `.puml` files to `.svg` images via the command line.

Prerequisites

1. **Java Runtime Environment (JRE):** Required to execute PlantUML.
2. **PlantUML JAR File:** The standalone application.

1. Download PlantUML

Get the latest stable release of `plantuml.jar` from the official site:
👉 https://sourceforge.net/projects/plantuml/files/

2. Conversion Command

Navigate to the folder containing both `plantuml.jar` and your `.puml` file.

Use the `-tsvg` flag to generate an SVG image:

Command	**Action**
`java -jar plantuml.jar -tsvg yourfile.puml`	Converts the input file (`.puml`) to an SVG output (`.svg`).

Example

```
# Generates 'MyDiagram.svg'
java -jar plantuml.jar -tsvg MyDiagram.puml
```