

# Interactive Web Interface for Contrastive Explanation of Plans in Hybrid Domains: User Manual

## ***Introduction***

In this user manual, we will introduce the features and usage of an interactive web interface designed to provide contrastive explanations of plans in hybrid domains. The tool aims to address the need for understanding why specific plans are chosen over alternatives, allowing users to explore contrastive questions and analyze plan characteristics. We will outline the key components of the tool, including the framework for contrastive explanations and the iterative re-modeling and re-planning algorithm. Additionally, we will discuss the provision for experimenting with different planning domains and using various hybrid system planners. Finally, we will highlight the experimental results obtained using two state-of-the-art planners on different planning domains.

## ***System Requirements***

Before running the application, ensure that your device meets the following requirements:

- Ubuntu 20.04 or later
- Node.js version 12.x or later
- npm package manager
- SMTPLAN+ AI Planner
- ENHSP AI Planner
- Python 3.6 or higher

## ***Getting Started***

1. Clone the repository to your local machine.
2. Open your terminal and navigate to the project directory.
3. Run the command "npm install" to install the required dependencies.
4. Download and install Node.js using the command "sudo apt-get install -y nodejs" (for Ubuntu).
5. Verify the successful installation of Node.js and npm by querying their version numbers using "node --version" and "npm --version".
6. Ensure that SMTPLAN+ is installed in the common location and copy it to the /usr/local/bin directory using the command "sudo cp -r /path/to/your/file /usr/local/bin/".
7. Once the dependencies are installed, start the application by running "npm start" in the terminal.
8. The application will launch, and you can access it through your web browser at <http://localhost:3000>.

## ***Troubleshooting***

If you encounter any issues while running the application, try the following steps:

1. Close the application and restart it.
2. Ensure that all the required dependencies are correctly installed and up to date.

3. Double-check that the SMTPLAN+ and ENHSP AI Planners are properly configured.
4. If the problem persists, refer to the documentation or contact the developers through the provided GitHub repository for assistance.

## Usage

### 1. Domain and Problem Selection:

- Choose the domain and enter the corresponding domain and problem files.

#### A Contrastive Plan Explanation Framework for Hybrid System Models



In artificial intelligence planning, having an explanation of a plan given by a planner is often desirable. The ability to explain various aspects of a synthesized plan to an end-user not only brings in trust in the planner but also reveals insights into the planning domain and the planning process. Contrastive questions such as "Why action A instead of action B?" can be answered with a contrastive explanation that compares the properties of the original plan containing A against the contrastive plan containing B. In our work, we explore a set of contrastive questions that a user of a planning tool may raise and we propose a re-model and re-plan framework to provide explanations to such questions. We have used PDDL+, a planning domain definition language to describe planning instances of hybrid systems which model a mix of discrete-continuous dynamics. Specifically, given a mixed discrete-continuous system model in PDDL+ and a plan describing the set of desirable actions on the same to achieve a destined goal, we present a framework that can integrate contrastive questions in PDDL+ and synthesize alternate plans. We compare the original plan with the alternate ones to generate an explanation.

Domain file  car\_domain\_nodrag.pddl    Problem File  car\_prob01.pddl    Select the Planner

- Select the desired planner (say, SMTPLAN+) for generating the initial plan.

Select the Planner

-The original Plan

## The following is the plan produced by smtplan

Time / Action / Duration

```
0.0: (accelerate) [0.0]
1.0: (decelerate) [0.0]
31.0: (decelerate) [0.0]
32.0: (stop) [0.0]
```

Choose a contrastive question: Replacing an Action by Another

Submit

### 2. Contrastive Questions:

- To explore contrastive explanations, select a question from the provided menu.

## The following is the plan produced by smtplan

Time / Action / Duration

```
0.0: (accelerate) [0.0]
1.0: (decelerate) [0.0]
31.0: (decelerate) [0.0]
32.0: (stop) [0.0]
```

Choose a contrastive question: Replacing an Action by Another

Submit

Replacing an Action by Another  
Restricting an Action to Appear After a certain time  
Restricting an Action to Appear Before a certain time  
Barring an Action from Appearing  
Restricting an Action to occur less than certain number of time  
Questioning the optimality of Plan Duration  
Question on the sequence of Action  
Questioning the optimality of Plan Length

- For example, choose the question "Restricting an Action to Appear Before a particular Time."
- Complete the input form, specifying the relevant action and time to bind with the placeholders in the question.

The selected contrastive question is: Restricting an Action to Appear Before a Certain Time

action

decelerate

appears before  
time(sec)

|

Submit Form

- Submit the form to proceed.

### 3. *Contrastive Plan and Analysis:*

- The tool will present the contrastive plan (HPlan) that addresses the selected question.



action is *decelerate*, appears BEFORE 1 seconds

```
0.0:    (accelerate) [0.0]
0.75:   (decelerate_new) [0.0]
40.75:  (decelerate) [0.0]
41.5:   (stop) [0.0]
```

Show  
optimal  
Length

Show optimal

- ① original plan is better in terms of number of actions
- ① original plan is better in terms of makespan

- The plan will highlight the differences between the original plan and the alternate plan.
- Use the "show optimal" and "show optimal length" buttons to generate near-optimal plans based on makespan and length, respectively.

The following is the optimal plan produced by smtplan

Time / Action / Duration

```
0.0:    (accelerate) [0.0]
0.5:    (decelerate_new) [0.0]
0.609375: (accelerate) [0.0]
5.359375: (decelerate) [0.0]
5.814453125: (decelerate) [0.0]
11.064453125: (stop) [0.0]
```

- Analyze the generated plans to gain insights into the decision-making process and understand the trade-offs made by the planner.

### **Conclusion**

This user manual has provided an overview of the interactive web interface for contrastive explanation of plans in hybrid domains. The tool offers a framework for addressing contrastive questions and supports experimentation with different planning domains and