

# Module Interface Specification for Projectile

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# Contents

|          |  |          |
|----------|--|----------|
| <b>1</b> | <b>Symbols, Abbreviations and Acronyms</b> | <b>1</b> |
| <b>2</b> | <b>Introduction</b>                        | <b>1</b> |
| <b>3</b> | <b>Notation</b>                            | <b>1</b> |
| <b>4</b> | <b>Module Decomposition</b>                | <b>2</b> |
| <b>5</b> | <b>MIS of Control Module</b>               | <b>3</b> |
| 5.1      | Module . . . . .                           | 3        |
| 5.2      | Uses . . . . .                             | 3        |
| 5.3      | Syntax . . . . .                           | 3        |
| 5.3.1    | Exported Constants . . . . .               | 3        |
| 5.3.2    | Exported Access Programs . . . . .         | 3        |
| 5.4      | Semantics . . . . .                        | 3        |
| 5.4.1    | State Variables . . . . .                  | 3        |
| 5.4.2    | Access Routine Semantics . . . . .         | 3        |
| <b>6</b> | <b>MIS of Input Parameters Module</b>      | <b>4</b> |
| 6.1      | Module . . . . .                           | 4        |
| 6.2      | Uses . . . . .                             | 4        |
| 6.3      | Syntax . . . . .                           | 4        |
| 6.4      | Semantics . . . . .                        | 4        |
| 6.4.1    | Environment Variables . . . . .            | 4        |
| 6.4.2    | State Variables . . . . .                  | 4        |
| 6.4.3    | Assumptions . . . . .                      | 5        |
| 6.4.4    | Access Routine Semantics . . . . .         | 5        |
| 6.5      | Considerations . . . . .                   | 6        |
| <b>7</b> | <b>MIS of Output Module</b>                | <b>7</b> |
| 7.1      | Module . . . . .                           | 7        |
| 7.2      | Uses . . . . .                             | 7        |
| 7.3      | Syntax . . . . .                           | 7        |
| 7.3.1    | Exported Access Program . . . . .          | 7        |
| 7.4      | Semantics . . . . .                        | 7        |
| 7.4.1    | State Variables . . . . .                  | 7        |
| 7.4.2    | Environment Variables . . . . .            | 7        |
| 7.4.3    | Access Routine Semantics . . . . .         | 7        |

|           |  |          |
|-----------|--|----------|
| <b>8</b>  | <b>MIS of Specification Parameters</b> | <b>8</b> |
| 8.1       | Module . . . . .                       | 8        |
| 8.2       | Uses . . . . .                         | 8        |
| 8.3       | Syntax . . . . .                       | 8        |
| 8.3.1     | Exported Constants . . . . .           | 8        |
| 8.4       | Semantics . . . . .                    | 8        |
| <b>9</b>  | <b>Bibliography</b>                    | <b>9</b> |
| <b>10</b> | <b>Appendix</b>                        | <b>9</b> |

# 1 Symbols, Abbreviations and Acronyms

See SRS Documentation at [https://jacquescarette.github.io/Drasil/examples/Projectile/srs/Projectile\\_SRS.pdf](https://jacquescarette.github.io/Drasil/examples/Projectile/srs/Projectile_SRS.pdf)

## 2 Introduction

The following document details the Module Interface Specifications for the implemented modules in a program simulating projectile motion. It is intended to ease navigation through the program for design and maintenance purposes.

Complementary documents include the System Requirement Specifications and Module Guide. The full documentation and implementation can be found at [No manual version of Projectile? Should this link be removed or should there be a link? —SC].

## 3 Notation

The structure of the MIS for modules comes from Hoffman and Strooper (1995), with the addition that template modules have been adapted from Ghezzi et al. (2003). The mathematical notation comes from Chapter 3 of Hoffman and Strooper (1995). For instance, the symbol  $:=$  is used for a multiple assignment statement and conditional rules follow the form  $(c_1 \Rightarrow r_1 | c_2 \Rightarrow r_2 | \dots | c_n \Rightarrow r_n)$ .

The following table summarizes the primitive data types used by Projectile.

| Data Type | Notation     | Description                       |
|-----------|--------------|-----------------------------------|
| character | char         | a single symbol or digit          |
| real      | $\mathbb{R}$ | any number in $(-\infty, \infty)$ |

The specification of Projectile uses strings, a derived data type. Strings are lists of characters. In addition, Projectile uses functions, which are defined by the data types of their inputs and outputs. Local functions are described by giving their type signature followed by their specification.

## 4 Module Decomposition

The following table is taken directly from the Module Guide document for this project.

| Level 1           | Level 2   |
|-------------------|---|
| Hardware-Hiding   |   |
| Behaviour-Hiding  | Input Parameters<br>Output Format<br>Output Verification<br>Control Module<br>Specification Parameters Module |
| Software Decision | Sequence Data Structure   |

Table 1: Module Hierarchy

## 5 MIS of Control Module

### 5.1 Module

main

### 5.2 Uses

Param (Section 6), verify\_output (Section ??), output (Section 7)

### 5.3 Syntax

#### 5.3.1 Exported Constants

filenameOut = “output”

#### 5.3.2 Exported Access Programs

| Name | In | Out | Exceptions |
|------|----|-----|------------|
| main | -  | -   | -          |

### 5.4 Semantics

#### 5.4.1 State Variables

None

#### 5.4.2 Access Routine Semantics

main():

- transition: Modify the state of Param module and the environment variables for the Output module by following these steps

Get (filenameIn: string) from user.

load\_params(filenameIn)

*#Output calculated values to a file.*

output(filenameOut,  $t_{\text{message}}$ ,  $t_{\text{output}}$ )

## 6 MIS of Input Parameters Module

The secrets of this module are the data structure for input parameters, how the values are input and how the values are verified. The load and verify secrets are isolated to their own access programs.

### 6.1 Module

Param

### 6.2 Uses

SpecParam (Section 8)

### 6.3 Syntax

| Name                | In     | Out          | Exceptions |
|---------------------|--------|--------------|------------|
| load_params         | string | -            | FileError  |
| verify_params       | -      | -            | InputError |
| $v$                 | -      | $\mathbb{R}$ |            |
| $\theta$            | -      | $\mathbb{R}$ |            |
| $p_{\text{target}}$ | -      | $\mathbb{R}$ |            |
| $p_{\text{land}}$   | -      | $\mathbb{R}$ |            |
| offset              | -      | $\mathbb{R}$ |            |
| message             | -      | string       |            |

### 6.4 Semantics

#### 6.4.1 Environment Variables

inputFile: sequence of string  $\#f[i]$  is the  $i$ th string in the text file  $f$

#### 6.4.2 State Variables

# To Support IM1 and IM2

$v: \mathbb{R}$

$\theta: \mathbb{R}$

# To Support IM3 and IM4

$p_{\text{target}}: \mathbb{R}$

# From FR4

$p_{\text{land}}: \mathbb{R}$

offset:  $\mathbb{R}$   
message: string

### 6.4.3 Assumptions

- load\_params will be called before the values of any state variables will be accessed.
- The file contains the string equivalents of the numeric values for each input parameter in order, each on a new line. Any comments in the input file should be denoted with a '#' symbol.

### 6.4.4 Access Routine Semantics

Param.v:

- output:  $out := v$
- exception: none

Param. $\theta$ :

- output:  $out := \theta$
- exception: none

Param. $p_{\text{target}}$ :

- output:  $out := p_{\text{target}}$
- exception: none

Param. $p_{\text{land}}$ :

- output:  $out := p_{\text{land}}$
- exception: none

Param.offset:

- output:  $out := \text{offset}$
- exception: none

Param.message:

- output:  $out := \text{message}$
- exception: none

load\_params( $s$ ):



- transition: The filename  $s$  is first associated with the file  $f$ . `inputFile` is used to modify the state variables using the following procedural specification:

1. Read data sequentially from `inputFile` to populate the state variables from FR1 ( $v$ ,  $\theta$ , and  $p_{\text{target}}$ ).
2. Calculate the derived quantities ( $p_{\text{land}}$ , `offset`, and `message`) as follows:
  - $p_{\text{land}} := \frac{2v^2 \sin(\theta) \cos(\theta)}{g}$
  - `offset` :=  $p_{\text{land}} - p_{\text{target}}$
  - `message` :=

$|\frac{\text{offset}}{p_{\text{target}}}| < \epsilon \Rightarrow$  “The target was hit.”  
`offset` < 0  $\Rightarrow$  “The projectile fell short.”  
`True`  $\Rightarrow$  “The projectile went long.”

### 3. `verify_params()`

- exception: `exc` := a file name  $s$  cannot be found OR the format of `inputFile` is incorrect  $\Rightarrow$  `FileError`

`verify_params()`:

- out: `out` := none
- exception: `exc` :=

$\neg(0 < v) \Rightarrow$  `badVelocity`  
 $\neg(0 < \theta < \frac{\pi}{2}) \Rightarrow$  `badAngle`  
 $\neg(0 < p_{\text{target}}) \Rightarrow$  `badTargetPosition`

See Appendix (Section 10) for the complete list of exceptions and associated error messages.

## 6.5 Considerations

The value of each state variable can be accessed through its name (getter). An access program is available for each state variable. There are no setters for the state variables, since the values will be set and checked by `load params` and not changed for the life of the program.

## 7 MIS of Output Module

### 7.1 Module

output

### 7.2 Uses

Param (Section 6)

### 7.3 Syntax

#### 7.3.1 Exported Access Program

| Name   | In  | Out | Exceptions |
|--------|---|-----|------------|
| output | fname: string, message : $\mathbb{R}$ , offset : $\mathbb{R}$ | -   | -          |

### 7.4 Semantics

#### 7.4.1 State Variables

None

#### 7.4.2 Environment Variables

file: A text file

#### 7.4.3 Access Routine Semantics

output(fname, message, offset):

- transition: Write to environment variable named fname the calculated values message and offset.
- exception: none

## 8 MIS of Specification Parameters

The secrets of this module is the value of the specification parameters.

### 8.1 Module

SpecParam

### 8.2 Uses

N/A

### 8.3 Syntax

#### 8.3.1 Exported Constants

# From Table 10 in SRS

$g := 9.8$

$\epsilon := 0.02$

### 8.4 Semantics

N/A

## 9 Bibliography

Carlo Ghezzi, Mehdi Jazayeri, and Dino Mandrioli. *Fundamentals of Software Engineering*. Prentice Hall, Upper Saddle River, NJ, USA, 2nd edition, 2003.

Daniel M. Hoffman and Paul A. Strooper. *Software Design, Automated Testing, and Maintenance: A Practical Approach*. International Thomson Computer Press, New York, NY, USA, 1995.

## 10 Appendix

| Message ID        | Error Message   |
|-------------------|---|
| badVelocity       | InputError: Velocity must be positive.                          |
| badAngle          | InputError: Angle must be between zero and pi over two radians. |
| badTargetPosition | InputError: Target position must be positive.                   |

Table 2: Possible Exceptions