

# Module Interface Specification for 2D Localizer

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# 1 Revision History

Date	Version	Notes
2025/03/19	1.0	Initial Draft

## 2 Symbols, Abbreviations and Acronyms

See SRS Documentation at <https://github.com/AliyahJimoh/2D-Localizer/blob/main/docs/SRS/SRS.pdf>

[Also add any additional symbols, abbreviations or acronyms —SS]

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### 3 Introduction

The following document details the Module Interface Specifications for 2D Localizer, a program that implements various sensors to help localize mobile robots on a 2D plane in enclosed environments.

Complementary documents include the System Requirement Specifications and Module Guide. The full documentation and implementation can be found at <https://github.com/AliyahJimoh/2D-Localizer>.

### 4 Notation

[You should describe your notation. You can use what is below as a starting point. —SS]

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 2D Localizer.

Data Type	Notation	Description
character	char	a single symbol or digit
integer	$\mathbb{Z}$	a number without a fractional component in $(-\infty, \infty)$
natural number	$\mathbb{N}$	a number without a fractional component in $[1, \infty)$
real	$\mathbb{R}$	any number in $(-\infty, \infty)$

The specification of 2D Localizer uses some derived data types: sequences, strings, and tuples. Sequences are lists filled with elements of the same data type. Strings are sequences of characters. Tuples contain a list of values, potentially of different types. In addition, 2D Localizer 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.

### 5 Module Decomposition

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

Level 1	Level 2
Hardware-Hiding Module	
	Input Format Module
	Output Format Module
	Localization Module
Behaviour-Hiding Module	Control Module
	Accuracy Evaluation Module
Software Decision Module	Plotting Module

Table 1: Module Hierarchy



## 6 MIS of Control Module

[Use labels for cross-referencing —SS]

[You can reference SRS labels, such as R2. —SS]

[It is also possible to use L<sup>A</sup>T<sub>E</sub>X for hyperlinks to external documents. —SS]

### 6.1 Module

main

### 6.2 Uses

### 6.3 Syntax

#### 6.3.1 Exported Constants

#### 6.3.2 Exported Access Programs

Name	In	Out	Exceptions
[accessProg —SS]	-	-	-

### 6.4 Semantics

#### 6.4.1 State Variables

[Not all modules will have state variables. State variables give the module a memory. —SS]

#### 6.4.2 Environment Variables

[This section is not necessary for all modules. Its purpose is to capture when the module has external interaction with the environment, such as for a device driver, screen interface, keyboard, file, etc. —SS]

#### 6.4.3 Assumptions

[Try to minimize assumptions and anticipate programmer errors via exceptions, but for practical purposes assumptions are sometimes appropriate. —SS]

#### 6.4.4 Access Routine Semantics

[accessProg —SS]():

- transition: [if appropriate —SS]
- output: [if appropriate —SS]

- exception: [if appropriate —SS]

[A module without environment variables or state variables is unlikely to have a state transition. In this case a state transition can only occur if the module is changing the state of another module. —SS]

[Modules rarely have both a transition and an output. In most cases you will have one or the other. —SS]

#### **6.4.5 Local Functions**

[As appropriate —SS] [These functions are for the purpose of specification. They are not necessarily something that is going to be implemented explicitly. Even if they are implemented, they are not exported; they only have local scope. —SS]

## 7 MIS of Input Format Module

[Use labels for cross-referencing —SS]

[You can reference SRS labels, such as R2. —SS]

[It is also possible to use L<sup>A</sup>T<sub>E</sub>X for hyperlinks to external documents. —SS]

### 7.1 Module

user\_input

### 7.2 Uses

### 7.3 Syntax

#### 7.3.1 Exported Constants

#### 7.3.2 Exported Access Programs

Name	In	Out	Exceptions
[accessProg —SS]	-	-	-

### 7.4 Semantics

#### 7.4.1 State Variables

[Not all modules will have state variables. State variables give the module a memory. —SS]

#### 7.4.2 Environment Variables

[This section is not necessary for all modules. Its purpose is to capture when the module has external interaction with the environment, such as for a device driver, screen interface, keyboard, file, etc. —SS]

#### 7.4.3 Assumptions

[Try to minimize assumptions and anticipate programmer errors via exceptions, but for practical purposes assumptions are sometimes appropriate. —SS]

#### 7.4.4 Access Routine Semantics

[accessProg —SS]():

- transition: [if appropriate —SS]
- output: [if appropriate —SS]

- exception: [if appropriate —SS]

[A module without environment variables or state variables is unlikely to have a state transition. In this case a state transition can only occur if the module is changing the state of another module. —SS]

[Modules rarely have both a transition and an output. In most cases you will have one or the other. —SS]

#### **7.4.5 Local Functions**

[As appropriate —SS] [These functions are for the purpose of specification. They are not necessarily something that is going to be implemented explicitly. Even if they are implemented, they are not exported; they only have local scope. —SS]

## 8 MIS of Localization Module

[Use labels for cross-referencing —SS]

[You can reference SRS labels, such as R2. —SS]

[It is also possible to use L<sup>A</sup>T<sub>E</sub>X for hyperlinks to external documents. —SS]

### 8.1 Module

localization

### 8.2 Uses

### 8.3 Syntax

#### 8.3.1 Exported Constants

#### 8.3.2 Exported Access Programs

Name	In	Out	Exceptions
[accessProg —SS]	-	-	-

### 8.4 Semantics

#### 8.4.1 State Variables

[Not all modules will have state variables. State variables give the module a memory. —SS]

#### 8.4.2 Environment Variables

[This section is not necessary for all modules. Its purpose is to capture when the module has external interaction with the environment, such as for a device driver, screen interface, keyboard, file, etc. —SS]

#### 8.4.3 Assumptions

[Try to minimize assumptions and anticipate programmer errors via exceptions, but for practical purposes assumptions are sometimes appropriate. —SS]

#### 8.4.4 Access Routine Semantics

[accessProg —SS]():

- transition: [if appropriate —SS]
- output: [if appropriate —SS]

- exception: [if appropriate —SS]

[A module without environment variables or state variables is unlikely to have a state transition. In this case a state transition can only occur if the module is changing the state of another module. —SS]

[Modules rarely have both a transition and an output. In most cases you will have one or the other. —SS]

#### **8.4.5 Local Functions**

[As appropriate —SS] [These functions are for the purpose of specification. They are not necessarily something that is going to be implemented explicitly. Even if they are implemented, they are not exported; they only have local scope. —SS]

## 9 MIS of Accuracy Evaluation Module

[Use labels for cross-referencing —SS]

[You can reference SRS labels, such as R2. —SS]

[It is also possible to use L<sup>A</sup>T<sub>E</sub>X for hyperlinks to external documents. —SS]

### 9.1 Module

accuracy

### 9.2 Uses

### 9.3 Syntax

#### 9.3.1 Exported Constants

#### 9.3.2 Exported Access Programs

Name	In	Out	Exceptions
[accessProg —SS]	-	-	-

### 9.4 Semantics

#### 9.4.1 State Variables

[Not all modules will have state variables. State variables give the module a memory. —SS]

#### 9.4.2 Environment Variables

[This section is not necessary for all modules. Its purpose is to capture when the module has external interaction with the environment, such as for a device driver, screen interface, keyboard, file, etc. —SS]

#### 9.4.3 Assumptions

[Try to minimize assumptions and anticipate programmer errors via exceptions, but for practical purposes assumptions are sometimes appropriate. —SS]

#### 9.4.4 Access Routine Semantics

[accessProg —SS]():

- transition: [if appropriate —SS]
- output: [if appropriate —SS]

- exception: [if appropriate —SS]

[A module without environment variables or state variables is unlikely to have a state transition. In this case a state transition can only occur if the module is changing the state of another module. —SS]

[Modules rarely have both a transition and an output. In most cases you will have one or the other. —SS]

#### **9.4.5 Local Functions**

[As appropriate —SS] [These functions are for the purpose of specification. They are not necessarily something that is going to be implemented explicitly. Even if they are implemented, they are not exported; they only have local scope. —SS]



## 10 MIS of Output Format Module

[Use labels for cross-referencing —SS]

[You can reference SRS labels, such as R2. —SS]

[It is also possible to use L<sup>A</sup>T<sub>E</sub>X for hyperlinks to external documents. —SS]

### 10.1 Module

output

### 10.2 Uses

### 10.3 Syntax

#### 10.3.1 Exported Constants

#### 10.3.2 Exported Access Programs

Name	In	Out	Exceptions
[accessProg —SS]	-	-	-

### 10.4 Semantics

#### 10.4.1 State Variables

[Not all modules will have state variables. State variables give the module a memory. —SS]

#### 10.4.2 Environment Variables

[This section is not necessary for all modules. Its purpose is to capture when the module has external interaction with the environment, such as for a device driver, screen interface, keyboard, file, etc. —SS]

#### 10.4.3 Assumptions

[Try to minimize assumptions and anticipate programmer errors via exceptions, but for practical purposes assumptions are sometimes appropriate. —SS]

#### 10.4.4 Access Routine Semantics

[accessProg —SS]():

- transition: [if appropriate —SS]
- output: [if appropriate —SS]

- exception: [if appropriate —SS]

[A module without environment variables or state variables is unlikely to have a state transition. In this case a state transition can only occur if the module is changing the state of another module. —SS]

[Modules rarely have both a transition and an output. In most cases you will have one or the other. —SS]

#### **10.4.5 Local Functions**

[As appropriate —SS] [These functions are for the purpose of specification. They are not necessarily something that is going to be implemented explicitly. Even if they are implemented, they are not exported; they only have local scope. —SS]

## 11 MIS of Plotting Module

[Use labels for cross-referencing —SS]

[You can reference SRS labels, such as R2. —SS]

[It is also possible to use L<sup>A</sup>T<sub>E</sub>X for hyperlinks to external documents. —SS]

### 11.1 Module

plot

### 11.2 Uses

### 11.3 Syntax

#### 11.3.1 Exported Constants

#### 11.3.2 Exported Access Programs

Name	In	Out	Exceptions
[accessProg —SS]	-	-	-

### 11.4 Semantics

#### 11.4.1 State Variables

[Not all modules will have state variables. State variables give the module a memory. —SS]

#### 11.4.2 Environment Variables

[This section is not necessary for all modules. Its purpose is to capture when the module has external interaction with the environment, such as for a device driver, screen interface, keyboard, file, etc. —SS]

#### 11.4.3 Assumptions

[Try to minimize assumptions and anticipate programmer errors via exceptions, but for practical purposes assumptions are sometimes appropriate. —SS]

#### 11.4.4 Access Routine Semantics

[accessProg —SS]():

- transition: [if appropriate —SS]
- output: [if appropriate —SS]

- exception: [if appropriate —SS]

[A module without environment variables or state variables is unlikely to have a state transition. In this case a state transition can only occur if the module is changing the state of another module. —SS]

[Modules rarely have both a transition and an output. In most cases you will have one or the other. —SS]

#### **11.4.5 Local Functions**

[As appropriate —SS] [These functions are for the purpose of specification. They are not necessarily something that is going to be implemented explicitly. Even if they are implemented, they are not exported; they only have local scope. —SS]

## References

- 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. URL <http://citeseer.ist.psu.edu/428727.html>.

## 12 Appendix

[Extra information if required —SS]