Module Interface Specification for STEM Moiré GPA

Alexandre Pofelski
macid: pofelska
github: slimpotatoes

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1 Revision History

Date	Version	Notes
14/11/2017	1.0	First draft

2 Symbols, Abbreviations and Acronyms

The same Symbols, Abbreviations and Acronyms as in the SRS, the TestPlan and the MG (available in STEM Moiré GPA repository) are used in the Module Interface Specifications document.

addition to document

Contents

3 Introduction

The following document details the Module Interface Specifications for STEM Moiré GPA. The full documentation and implementation can be found in STEM Moiré GPA repository.

4 Notation

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

The following table summarizes the primitive data types used by STEM Moiré GPA.

Data Type	Notation	Description
character	char	a single symbol or digit
integer	$\mathbb{Z}$	an integer number
natural number	$\mathbb{N}$	a natural number
real	$\mathbb{R}$	a real number

The specification of STEM Moiré GPA 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, STEM Moiré GPA 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	
Behaviour-Hiding Module	Input STEM Moiré GPA Control STEM Moiré GPA GUI User Input SMH simulation GPA Mask Unstrained region Conversion 2D strain tensor
Software Decision Module	Fourier Transform Least square fitting method Phase calculation Gradient Generic GUI/Plot Data structure Object structure

Table 1: Module Hierarchy

LIST ALL MIS to refer them in other document

6 MIS of Hardware Hiding Module (M 1)

6.1 Module

6.2 Uses

Data Structure

6.3 Syntax

6.3.1 Exported Access Programs

Name	In	Out	Exceptions
	-	-	-

6.4 Semantics

6.4.1 State Variables

6.4.2 Access Routine Semantics

():

- transition:
- output:
- exception:

7 MIS of STEM Moiré GPA Control Module (M 2)

7.1 Module

main

7.2 Uses

- STEM Moié GPA GUI
- Processing modules
  - Unstrained region
  - Conversion
  - SMH Simulation
  - GPA

– 2D Strain Tensors

- Data Structure

7.3 Syntax

7.3.1 Exported Access Programs

Name	In	Out	Exceptions
	-	-	-

7.4 Semantics

STEM Moiré GPA is designed to have the different steps of the process flow driven by user directly through GUI_SMG. The STEM Moiré GPA Control Module uses the events in STEM Moié GPA GUI to use the processing modules in the order defined by the user.

7.4.1 State Variables

7.4.2 Access Routine Semantics

():

- transition:
- output:
- exception:

8 MIS of STEM Moiré GPA GUI Module (M 3)

8.1 Module

GUI_SMG

8.2 Uses

- Generic GUI/Plot
- Data Structure

8.3 Syntax

8.3.1 Exported Access Programs

Name	In	Out	Exceptions
	-	-	-

8.4 Semantics

STEM Moiré GPA process flow is driven by user through GUI_SMG. User triggers the events that start the wished processing step.

8.4.1 State Variables

8.4.2 Access Routine Semantics

():

- transition:
- output:
- exception:

9 MIS of Imput Module (M 4)

9.1 Module

Input

9.2 Uses

- STEM Moié GPA GUI
- Data Structure

9.3 Syntax

9.3.1 Exported Access Programs

Name	In	Out	Exceptions
	-	-	-

9.4 Semantics

9.4.1 State Variables

9.4.2 Access Routine Semantics

():

- transition:
- output:
- exception:

10 MIS of SMH Simulation (M 5)

10.1 Module

SMHSim

10.2 Uses

- Fourier Transform
- Input
- Data Structure

10.3 Syntax

10.3.1 Exported Access Programs

Name	In	Out	Exceptions
	-	-	-

10.4 Semantics

10.4.1 State Variables

10.4.2 Access Routine Semantics

():

- transition:
- output:
- exception:

11 MIS of GPA Module (M 6)

11.1 Module

GPA

11.2 Uses

- Mask
- Fourier Transform
- Phase
- Gradient
- Data Structure

11.3 Syntax

11.3.1 Exported Access Programs

Name	In	Out	Exceptions
	-	-	-

11.4 Semantics

11.4.1 State Variables

11.4.2 Access Routine Semantics

():

- transition:
- output:
- exception:

12 MIS of Mask Module (M 7)

12.1 Module

GPA

12.2 Uses

- Mask
- Fourier Transform
- Phase
- Gradient
- Data Structure

12.3 Syntax

12.3.1 Exported Access Programs

Name	In	Out	Exceptions
	-	-	-

12.4 Semantics

12.4.1 State Variables

12.4.2 Access Routine Semantics

():

- transition:
- output:
- exception:

13 MIS of Unstrained region (M 8)

13.1 Module

URef

13.2 Uses

- Least Square Fit
- Input
- Data Structure

13.3 Syntax

13.3.1 Exported Access Programs

Name	In	Out	Exceptions
	-	-	-

13.4 Semantics

13.4.1 State Variables

13.4.2 Access Routine Semantics

():

- transition:
- output:
- exception:

14 MIS of Conversion Module (M 9)

14.1 Module

MtoCConv

14.2 Uses

- Input
- Data Structure

14.3 Syntax

14.3.1 Exported Access Programs

Name	In	Out	Exceptions
	-	-	-

14.4 Semantics

14.4.1 State Variables

14.4.2 Access Routine Semantics

():

- transition:
- output:
- exception:

15 MIS of 2D Strain Tensor Module (M 10)

15.1 Module

2D_Strain

15.2 Uses

Data Structure

15.3 Syntax

15.3.1 Exported Access Programs

Name	In	Out	Exceptions
	-	-	-

15.4 Semantics

15.4.1 State Variables

15.4.2 Access Routine Semantics

():

- transition:
- output:
- exception:

16 MIS of Fourier Transform Module (M 11)

 # 2D Fourier transform

16.1 Module

FTCalc

16.2 Uses

Data Structure

16.3 Syntax

16.3.1 Exported Access Programs

Name	In	Out	Exceptions
$\mathcal{FT}$	$f : \mathbb{R}^2 \to \mathbb{R}$	$f : \mathbb{R}^2 \to \mathbb{C}$	-
i$\mathcal{FT}$	$f : \mathbb{R}^2 \to \mathbb{C}$	$f : \mathbb{R}^2 \to \mathbb{R}$	-

16.4 Semantics

16.4.1 State Variables

None

16.4.2 Access Routine Semantics

 # Calculating the 2D Fourier transform of a function f

$\mathcal{FT}(f(x, y))$:

- output: $\widetilde{f}(\nu, \mu)$ such that

$$\forall(\nu, \mu) \in \mathbb{R}^2 \wedge \forall(x, y) \in \mathbb{R}^2,\ \widetilde{f}(\nu, \mu) \int \int_{-\infty}^{\infty} f(x, y) e^{-2i\pi(\nu x + \mu y)} dxdy$$

- exception:

 # Calculating the inverse 2D Fourier transform of a function $\widetilde{f}$

i$\mathcal{FT}(\widetilde{f}(\nu, \mu))$:

- output: $f(x, y)$ such that

$$\forall(x, y) \in \mathbb{R}^2 \wedge \forall(\nu, \mu) \in \mathbb{R}^2,\ f(x, y) = \int \int_{-\infty}^{\infty} \widetilde{f}(\nu, \mu) e^{2i\pi(\nu x + \mu y)} dxdy$$

- exception:

17 MIS of Gradient Module (M 12)

17.1 Module

Gradient

17.2 Uses

Data Structure

17.3 Syntax

17.3.1 Exported Access Programs

Name	In	Out	Exceptions
	-	-	-

17.4 Semantics

17.4.1 State Variables

17.4.2 Access Routine Semantics

():

- transition:
- output:
- exception:

18 MIS of Least Square Fit Method Module (M 13)

18.1 Module

LSFM

18.2 Uses

Data Structure

18.3 Syntax

18.3.1 Exported Access Programs

Name	In	Out	Exceptions
	-	-	-

18.4 Semantics

18.4.1 State Variables

18.4.2 Access Routine Semantics

():

- transition:

- output:
- exception:

19 MIS of Phase Operation Module (M 14)

19.1 Module

PhaseCalc

19.2 Uses

Data Structure

19.3 Syntax

19.3.1 Exported Access Programs

Name	In	Out	Exceptions
	-	-	-

19.4 Semantics

19.4.1 State Variables

19.4.2 Access Routine Semantics

():

- transition:
- output:
- exception:

20 MIS of Data Structure Module (M 15)

20.1 Module

DataStruct

20.2 Uses

20.3 Syntax

20.3.1 Exported Access Programs

Name	In	Out	Exceptions
set	Metadata	-	-

20.4 Semantics

20.4.1 State Variables

20.4.2 Access Routine Semantics

():

- transition:
- output:
- exception:

21 MIS of Generic GUI/Plot Module (M 16)

21.1 Module

GUIGene

21.2 Uses

Hardware-Hiding Data Structure

21.3 Syntax

21.3.1 Exported Access Programs

Name	In	Out	Exceptions
	-	-	-

21.4 Semantics

21.4.1 State Variables

21.4.2 Access Routine Semantics

():

- transition:
- output:
- exception:

22 Appendix