Potku Software Project

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System Testing Plan

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Abstract: Potku project developes a user interface for a software used in analyzation and visualization of a measurement data collected with a ToF-ERD telescope. The system testing plan describes the testing enveronment as the well as the test cases of the system testing. The results as well as the found faults and deficiencies will be reported to the document in each testing time.
Keywords: Python, testing, testing enveronments, test cases, testing practices, system testing.

Revision History

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Information of the Project

Potku project developes a user interface for a software to be used in analyzation and visualization of a measurement data collected with a ToF-ERD telescope. The Department of Physics at the University of Jyväskylä is the customer of the project.

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Contents

1 Introduction

In the student software project course in spring of 2013, Potku project developes a user interface for a software for the material physics research team in the Department of Physics at University of Jyväskylä. The application will be used to analyse the measurement data collected with the team's recoil spectrometer. The software can be used to form Time-of-Flight-Energy histograms and elemental depth profiles from the acquired data.

The testing ensures that the software implementation includes the needed functionalities specified by the customer, as well as the requirements. The system test plan describes testing practices of application in the project. The approach is to test developed software blocks, when they are ready to be integrated. Once the blocks are working as intended, they are integrated to the system. Software verification is carried out with system testing on Windows, Linux, and Macintosh operating system environments.

System Testing Plan consist of 14 chapters. The second chapter describes different software testing levels and the testing environments. The third chapter includes information about the testing. The test cases are described in the Chapters 4 – 12 and Chapter 13 includes non-implemented requirements.

2 The Testing Practices

2.1 Testing Levels

The testing to be carried out ensures that the software meets the desired functionalities specified by the project team, as well as the customers needs. The purpose of the testing is to verify that the application fulfills it's functional and qualitative requirements. The requirements will be met when the testing is succesfully carried out with the unit and system tests.

Unit tests were planned to be programmed to each program module, but unfortunately the project group had no time to write unit test to each module. The aim of the unit testing is to find individual programming errors. Actual testing is the responsibility of all project group members.

The purpose of system testing is to ensure that the analysis results produced by the software are correct in comparison to the results produced by Finlandia software. Actual testing will be carried out by all project group members.

The testing result should be noted with one of the three different outcomes:

- OK, if test passes.
- Fail, if test fails.
- Note, if the tester wants to make notices about the test.

2.2 Regression Testing

The project team corrects the discovered errors according to their present state knowledge and resources. The project team corrects the detected errors as soon as they are reported in the testing plan. All the tests are performed again, to ensure that the software pass the test after modifigations.

An error or a lacking feature might be too grand to be fixed or implemented in a reasonable time in comparison to the potential gain. If it does not compromise the operation of the software and is not critical to the functionality of the software, it's correction shall be discussed with the representatives of the customer.

2.3 Testing Environments

The Requirement Specification [1] dictates that the software should work on Windows, Linux, and Macintosh operating systems. The following softwares are required for all the operating systems:

- Python-3.3.0
- numpy-MKL-1.7.0
- scipy-0.12.0.dev
- matplotlib-1.2.0
- PyQt4-4.10-gpl-Py3.3-Qt4.8.4.

MinGW development environment must be installed on Windows operating system, to support the external C-written components of the software.

3 Information about the Testing

The test cases in Chapters 4–12 are organized and written according to the requirements specification [1] and the project plan [2]. Chapter 13 includes the non-implemented requirements.

The purpose of Table 3.1 is to summarize information about the test execution including the date and the time, the operating system, the software version and the testing data. This information ensures that the test can be identified later on.

Date and Time:	
Testers:	
Operating System:	
Version of the application:	
Testing data:	
Notes:	

Table 3.1: Information about the Testing.

4 Test Cases for Project Management

4.1 Creating a New Project

Test Case	Result	Notes
1. Create a new project using Create a new project button.		
2. Create a new Project using the command in the file menu.		
3. Create a new Project using toolbar image button.		
4. A project name can be specified while creating a new project.		
5. User cannot create an unnamed project.		

Table 4.1: Creating a New Project.

4.2 Creating a New Measurement

Test Case	Result	Notes
1. Create a new measurement using Create a new Measurement button.		
2. Create a new measurement using the command in the file menu.		
3. Create a new measurement using the toolbar button New Measurement.		

Table 4.2: Creating a New Measurement.

4.3 Opening an Existing Project and an Existing Measurement

Test Case	Result	Notes
1. User can open an existing measurement using Open an Existing Project button.		
2. User can open an existing measurement using the command in the file menu.		
3. User can open an existing measurment using the toolbar button.		

Table 4.3: Opening an Existing Project and an Existing Measurement.

4.4 Opening, Saving and Managing a Measurement

Test Case	Result	Notes
1. By default the project is saved in the users' document directory.		
2. The project is saved in a logical folder structure.		
3. The project can include multiple measurements.		
4. Several measurements can be opened into the sample collection as tabs.		
5. User can remove a measurement if the project includes more than one measurements.		
6. User can remove the only measurement from a project.		

Table 4.4: Opening, Saving and Managing a measurement.

5 Test Cases for ToF-E Histogram

5.1 Graph Functionalities for ToF-E Histogram

Test Case	Result	Notes
1. The histogram data point count in a pixel is displayed via logarithmic coloring as a default.		
2. The histogram data point count in pixel can be displayed via linear coloring.		
3. The cursor coordinates are shown when hovering over the graph.		
4. User can drag the histogram when the pan button is enabled.		
5. When pan button is enabled the bins of the histogram axes can be specified by a non-negative integer.		
6. User can zoom the histogram when the zoom button is enabled.		
7. User can save histogram as an image file by pressing the save button.		

Table 5.1: Graph Functionalities for ToF-E Histogram.

5.2 Element Selection

Test Case	Result	Notes
1. The last node of an open selection can be cancelled.		
2. The element selection is shown with borders.		
3. User can manually load an element selection from a selection file.		
4. The element selection is automatically saved into selection file when a the selection is added, removed or modified.		
5. User can remove selections.		

Table 5.2: Element Selection.

5.3 Element Selection Settings

Test Case	Result	Notes
1. The element selections are saved in a cut file for each element specified with a type (ERD/RBS), an element mass, a weight factor and data points.		
2. User can highlight the selection when Select element button is enabled.		
3. User can save the element cuts from using right side ribbon view element.		
4. User can save the cut files from the mouse menu which is opened with the right mouse button.		

Table 5.3: Element Selection Settings.

6 Test Cases for ToF-E Graph Settings

6.1 ToF-E Sample Settings

Test Case	Result	Notes
1. An element uses an efficiency file if such exists.		
2. User can select an element.		
3. User can select standard atomic mass for an element.		
4. User can select an isotope.		
5. User can select the measure type between ERD and RBS.		
6. User can input a number value into the weight factor field.		
7. User cannot input text into the weight factor field.		

Table 6.1: ToF-E Sample Settings.

6.2 RBS Settings

Test Case	Result	Notes
1. When RBS type is selected user can select scatter elements.		

Table 6.2: RBS Settings.

6.3 Colour Settings

Test Case	Result	Notes
1. The periodic table is color-coded (automated color selection).		
2. User can select manually element colors.		

Table 6.3: ToF-E Coloring Settings.

6.4 ToF-E Graph Axis Settings

Test Case	Result	Notes
1. User can change the bins of the X-axis and Y-axis.		
2. User can invert X-axis and/or Y-axis of the histogram.		
3. User can transpose histogram axes (i.e. switch X-axis and Y-axis).		

Table 6.4: ToF-E Graph Axis Settings.

6.5 ToF-E Graph Histogram Coloring Settings

Test Case	Result	Notes
1. 2. User can change data color scheme of the histogram.		
3. User can apply new color settings.		
4. The changes to ToF-E graph settings do not apply by clicking the cancel button.		

Table 6.5: ToF-E Graph settings.

7 Test Cases for Project Settings

7.1 Loading and Saving Measurement Settings

Test Case	Result	Notes
1. User can load existing measurement setting in the project settings window.		
2. User can save new measurement settings in the define project settings window.		

Table 7.1: Loading and Saving Measurement Settings.

7.2 Beam Settings

Test Case	Result	Notes
1. User can select a beam element.		
2. User can select an isotope for the beam element.		
3. User can modify the value of the energy.		
4. User can enter a number value in the beam energy field.		
5. User cannot enter text into beam energy field.		

Table 7.2: Beam Settings.

7.3 Measurement Unit Settings

Test Case	Result	Notes
1. User can add a number value to Detector angle field.		
2. User cannot enter text into Detector angle field.		
3. User can add a number value into Target angle field.		
4. User cannot enter text into Target angle field.		
5. User can add a number value into Time of Fligth length field.		
6. User cannot enter text into Time of Fligth length field.		
7. User can add a number value into Carbon foil thickness field.		
8. User cannot enter text into the Carbon foil thickness field.		
9. User can add a number value into Target density field.		
10. User cannot enter text into Target density field.		

Table 7.3: Measurement Unit Settings.

7.4 Depth Profile Settings of the Project

Test Case	Result	Notes
1. User can load existing depth profile settings.		
2. User can name and save the depth profile settings.		
3. User can add a number value into Analysis depth input field.		
4. User cannot enter text into Analysis depth input field.		
5. User can add a number value into Bin width field.		
6. User cannot enter text into Bin width field.		

Table 7.4: Depth Profile Settings of the Project.

7.5 Concentration Scaling Settings

Test Case	Result	Notes
1. User can add a number value into From field of the concentration scaling.		
2. User cannot add a text value into From field of the concentration scaling.		
3. User can add a number value into To field of the concentration scaling.		
4. User cannot add a text value into To field of the concentration scaling.		

Table 7.5: Concentration Scaling Settings.

7.6 Calibration Parameters of the Project

Test Case	Result	Notes
1. User can load existing values for the calibration parameters.		
2. User can name and save the calibration settings.		
3. User can excecute TOF calibration.		
4. User can add a number value into Slope field.		
5. User cannot enter text into Slope field.		
6. User can add a number value into Offset field.		
7. User cannot add a text value into Offset field.		
8. User can set new project settings by pushing Apply or OK button.		
9. Project settings are not changed if the cancel button is pushed.		

Table 7.6: Calibration Parameters of the Project.

8 Test Cases fot Time of Flight Calibration

8.1 Fitting Tab in Time of Flight Calibration

Test Case	Result	Notes
1. User can select project's cut file and determine the position of the front edge of the histogram created from the data of the cut files.		
2. User can select project's cut file and determine the position of the front edge manually when Select the point manually button is enabled.		
3. User can change Bin width value.		
4. User can accept position of the front edge by clicking Accept point button.		
5. User can exit time of flight calibration view by clicking cancel button without accepting new values of the parameters.		

Table 8.1: Fitting tab in Time of Flight Calibration.

8.2 Calibration Tab in Time of Flight Calibration

Test Case	Result	Notes
1. User can remove one or more cut files from the Select Accepted Points area.		
2. When calibration is carried out user can confirm calibration results by clicking Accept calibration button.		
3. User can exit time of fligth calibration view without saving by clicking the cancel button.		

Table 8.2: Calibration Tab in Time of Flight Calibration.

9 Test Cases for Defining Measuring Unit for the Active Measurement

9.1 Active Measuring Common Settings

Test Case	Result	Notes
1. Use project settings values checkbox is enabled as default.		
2. When user disables project default settings he/she can change the measuring settings.		
3. User can load measuring settings.		
4. User can save the measuring settings.		

Table 9.1: Unit Settings for Active Measurement.

9.2 Beam Settings

Test Case	Result	Notes
1. User can select a beam element.		
2. User can selet an isotope for the beam element.		
3. User can add a number value into Energy field.		
4. User cannot add a text value into Energy field.		

Table 9.2: Beam Settings.

9.3 Measuring Unit Settings

Test Case	Result	Notes
1. User can add a number value into Detector angle field.		
2. User cannot add a text value into Detector angle field		
3. User can add a number value into Target angle field.		
4. User cannot add a text value into Target angle field.		
5. User can add a number value into Time of Flight length field.		
6. User cannot add a text value into Time of Fligth length field.		
7. User can add a number into Carbon foil thickness field.		
8. User cannot add a text value into Carbon foil thickness field.		
9. User can add a number into Target density field.		
10. User cannot add a text value into Target density field.		
11. User can set settings by clicking Set settings button.		
12. When user clicks Cancel button the new settings do not apply.		

Table 9.3: Measuring Unit Settings.

9.4 Defining Depth Profile Settings.

Test Case	Result	Notes
1. Use project settings values checkbox is enabled as default.		
2. User can load depth profile settings.		
3. User can save the depth profile settings.		
4. User can add a number value into Analysis Depth field.		
5. User cannot enter text value into Analysis Depth field.		
6. User can add a number value into Bin Width field.		
7. User cannot add a text value into Bin Width field.		
8. User can add a number value into From field in Concentration scaling.		
9. User cannot add a text value into From field in Concentration scaling.		
10. User can add a number value into To field in Concentration scaling.		
11. User cannot add a text value into To field in Concentration scaling.		
12. User can set setting by clicking Set setting button.		
13. When user clicks Cancel button the new settings do not apply.		

Table 9.4: Define Depth Profile Settings.

9.5 Defining ToF-E Calibration Parameters

Test Case	Result	Notes
1. Use project settings values checkbox is enabled as default.		
2. User can load existing calibration parameters.		
3. User can save the calibration parameters.		
User can execute calibration by clicking execute calibration button.		
4. User can add a number value into Slope field.		
5. User cannot add a text value into Slope field.		
6. User can add a number value into Offset field.		
7. User cannot add a text value into Offset field.		
8. User can set settings by clicking Set setting button.		
9. When user clicks Cancel button the new settings do not apply.		

Table 9.5: Define ToF-E Calibration Parameters for the Active Measurement Settings.

10 Test Cases for Analysing Elemental Losses

10.1 Target Cut Files Selection

Test Case	Result	Notes
1. Elemental losses divide a target cut file into the specified partition using a reference cut file (heavier element).		
2. All the cut files enabled will be displayed in Target cut files list.		
3. Multiple target cut files can be shown in the graph at the same time.		
4. User can select one or more cut files from the target cut file list.		
5. User can manually choose the reference cut file using the combobox.		
6. User can enter a number value into the split field.		
7. User cannot enter text into the split field.		
8. User can scale Y-axis either min-max or zero-max.		
9. When user clicks the apply or OK button, the new Axis setup is set.		
10. When user clicks the cancel button the new Axis settings are not set.		

Table 10.1: Target Cut Files Selection.

10.2 Elemental Losses Graph Options

Test Case	Result	Notes
1. The cursor coordinates are shown when hovering over the graph.		
2. User can drag the histogram when the pan button is enabled.		
3. When the pan button is enabled the bins of the histogram axes can be specified by a non-negative integer.		
4. User can zoom the histogram when the zoom button is enabled.		
5. The elemental losses can be saved manually into new partioned cut files with Save splits button.		

Table 10.2: Elemental Losses Graph Options.

11 Test Cases for Energy Spectrum

11.1 Creating a New Energy Spectrum Graph

Test Case	Result	Notes
1. User can create an energy spectrum by clicking Create energy spectrum ribbon view.		
2. User can add a number value into the histogram width field.		
3. User cannot enter text value into the histogram width field.		
4. User can select cut files into the measurement list.		
5. When user clicks OK button the new energy spectrum is drawn.		

Table 11.1: Create a New Energy Spectrum Graph.

11.2 Energy Spectrum Graph Options

Test Case	Result	Notes
1. The cursor coordinates are shown when hovering over the graph.		
2. User can drag the histogram when the pan button is enabled.		
3. When the pan button is enabled the bins of the histogram axes can be specified by a non-negative integer.		
4. User can zoom the histogram when the zoom button is enabled.		
5. User can save the energy spectrum figure by clicking Save the figure button.		

Table 11.2: Energy Spectrum Graph Options.

12 Test Cases for Depth Profile

12.1 Create Depth Profile Cut Files in the Measurement

Test Case	Result	Notes
1. All the cut files can be disabled in the cut files in the measurement list.		
2. User can select one or more cut files from the target cut file list.		
3. User can choose X-axis units either as nm or at/cm^2.		

Table 12.1: Create Depth Profile Cut Files in the Measurement.

12.2 Depth Profile Graph Functionalities

Test Case	Result	Notes
1. The X-axis ticks are rounded to integers (i.e. no decimals).		
2. The relative and absolute view of X-axis in the depth profile can be changed.		
3. The cursor coordinates are shown when hovering over graph.		
4. The depth distribution of the depth profile is shown on the graph outside the grid.		
5. User can drag the histogram when the pan button is enabled.		
6. When the pan button is enabled the bins of the histogram axes can be specified by a non-negative integer.		
7. User can zoom the depth profile histogram when the zoom button is enabled.		
8. User can save the depth profile figure by clicking Save the figure button.		
9. User can integrate the selected depth ratio of elements when the toggle selection is enabled.		
10. User can toggle the view of the horizontal line when the selection is enabled.		

Table 12.2: Depth Profile Graph Functionalities 1/2.

11. User can scale every channel to 100 % when relative or absolute selection is enabled.		
12. User can normalize Y-axis of the depth profile over the selected depth.		

Table 12.3: Depth Profile Graph Functionalities 2/2.

13 Non-Implemented Requirements

13.1 Specifying Measurement Data

Test Case	Result	Notes
1. The software reads a .lst file (binary) provided by a conversion (similar to Finlandia).		
2. The software reads a standardized XML format.		

Table 13.1: Specifying Measurement Data.

13.2 ToF-E Histogram

Test Case	Result	Notes
1. The histogram data point count in a pixel can be displayed via linear coloring		
2. The histogram axes functions can be specified manually.		
3. A starting point of element can be automatically estimated		
4. The event count in a pixel is displayed when hovering over with the cursor.		

Table 13.2: ToF-E Histogram.

13.3 Element Selection in ToF-E Histogram

Test Case	Result	Notes
1. Element selection can be highlighted by moving the cursor over selection.		
2. A node in an element selection can be removed.		
3. An element selection can be composed from several selections utilizing Booles operation.		

Table 13.3: Element Selection in ToF-E Histogram.

13.4 Element

Test Case	Result	Notes
1. An unstable element isotope can be chosen.		

Table 13.4: Element.

13.5 ToF Calibration

Test Case	Result	Notes
1. Cut files from outside the project can be specified for the calibration.		
2. Additional values of calibration parameters can be saved to a calibration file.		
3. Other saved calibrations can be chosen to be used.		
4. The previous calibration can be shown in the linear fit.		

Table 13.5: ToF Calibration.

13.6 Elemental Losses

Test Case	Result	Notes
1. An energy spectrum from a cut file can be generated.		

Table 13.6: Elemental Losses

13.7 Depth Profile Logic

Test Case	Result	Notes
1. Stopping model of depth profile's can be chosen.		
2. The margin of error can be displayed (none / automatic / manual) in the log.		
3. In depth profile count of elements' data points can be shown at the selected depth.		

Table 13.7: Depth Profile Logic

13.8 Depth Profile Graph

Test Case	Result	Notes
1. Text and font of Graph's can be changed.		
2. The depth at which Y-axis is normalized can be specified from the graph.		

Table 13.8: Depth Profile Graph

13.9 Project Management

Test Case	Result	Notes
1. Master measurement can be used to carry out analyzation on multiple measurements at the same time.		
2. Upon opening a project, the software loads the current stage from a Python file.		

Table 13.9: Project Management.

13.10 Python Interpreter Interface

Test Case	Result	Notes
1. GUI saves as a command log the process of a sample collection in a python file.		
2. A series of commands issued in GUI can be rerun through interpreter.		

Table 13.10: Python Interpreter Interface.

13.11 Reporting

Test Case	Result	Notes
1. A report includes the selected histograms in the project.		
2. A report includes the selected depth profiles in the project.		
3. A report includes the selected integrations of the selected depths in the depth profiles.		
4. A report includes the valurs of the parameters specified for the graphs.		
5. A report includes files in Gnuplot/GLE format.		

Table 13.11: Reporting.

13.12 Additional Functionalities

Test Case	Result	Notes
1. Show ratio between selected cut files .		
2. The software can be extended with plugins.		
3. The software plugin can convert data to read other formats.		
4. The software plugin can do Monte-Carlo simulation.		

Table 13.12: Additional Functionalities.

14 References

[1] Aalto Jarkko, Konu Timo, Kärkkäinen Samuli, Rahkonen Samuli ja Raunio Miika, "Potku-projektin vaatimusmäärittely", Jyväskylän yliopisto, tietotekniikan laitos, 2.5.2013.

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