xrf-explorerV2

FILE: XRF_ExplorerV2_acceptancetestplan.pdf

General information on the software documentation
version: 2024 October 02

---

xrf-explorerV2 is a research software toolkit developed by students at Eindhoven University of Technology (TU/e), for the Van Gogh Museum Amsterdam in a partnership with ASML. The toolkit is intended to be used for the integrated exploration of multimodal images, spectral data, and chemical mappings of a painting. The toolkit is developed to assist in the conservation science practice.

Project
The original prototype (V1) was created by a TU/e master's student from January–September 2023. The current version (V2) was developed by a team of TU/e bachelor students from April–July 2024.

Documentation
Five documentation files were delivered by the development team.
Together they form a comprehensive documentation package:

- XRF_ExplorerV2_userrequirementsdocument.pdf
- XRF_ExplorerV2_softwaredesigndocument.pdf
- XRF_ExplorerV2_acceptancetestplan.pdf
- XRF_ExplorerV2_softwaretransferdocument.pdf
- XRF_ExplorerV2_softwareusermanual.pdf

Acknowledgements
For the development, testing, and documenting of xrf-explorer, test data was provided by the Museum of Modern Art (New York) to the development team. It consisted of images and xrf scanning data of the "Portrait of Joseph Roulin" painting by Vincent van Gogh. Images of this painting are included in some of the documentation files for the purpose of explaining the software usage.

For more detailed information on this painting, including image licenses, we refer to:
https://www.moma.org/collection/works/79105

License
The documentation provided here is licensed under CC-0.

Software
The xrfexplorerV2 software itself (codebase and code documentation) can be found at the github repository "Olive-Groves/xrf-explorer" (see: https://github.com/olive-groves).

Acceptance Test Plan

2IPE0 SOFTWARE ENGINEERING PROJECT

July, 2024

GROUP 6

PROJECT TEAM

Adrien Verriele	1710303
Diego Rivera Garrido	1674196
Dirk Burgers	1653873
Iliyan Teofilov	1671952
Ivan Ivanov	1661469
Jan Bulthuis	1696866
Lotte Lakeman	1668137
Massimo Leal Martel	1662147
Pablo Benayas Penas	1667939
Ruben Savelkouls	1695347
Sonia Maxim	1675656

PROJECT MANAGERS
Antreas Efstathiou
Konstantinos Chanioglou

SUPERVISOR
Prof dr. R. Bloo

CLIENTS
Ana Martins
Lars Maxfield
Marco Roling

ABSTRACT

This document, the Acceptance Test Plan (ATP) serves as the testing plan of the XRF Explorer 2.0. The XRF Explorer 2.0 is a web application aimed at conservation scientists which facilitates the analysis of paintings. This application builds upon the foundations laid by Dominique van Berkum's master thesis project, which introduced a prototype for the XRF-XPLORER [1]. Moreover, the application is tailored to fit the requirements of the clients. This document outlines detailed test procedures for the requirements stated in the User Requirements Document (URD) and provides a detailed list of definitions, to ensure clarity throughout the document.

Contents

DOCUMENT STATUS SHEET

GENERAL

Document title	Acceptance Test Plan
Document identifier	ATP/1.5
Document authors	Dirk Burgers Lotte Lakeman Ruben Savelkouls Diego Rivera Garrido
Document status	Draft

DOCUMENT HISTORY

Version	Date	Authors	Reason
0.1	24-04-2024	Lotte Lakeman	Created document from document template
0.2	12-05-2024	Lotte Lakeman	Created the first draft of the abstract, introduction and test plan.
0.3	12-05-2024	Lotte Lakeman	Added some test cases.
0.4	22-05-2024	Dirk Burgers	Added test cases for dimensionality reduction.
0.5	28-05-2024	Lotte Lakeman	Added some additional test cases.
0.6	28-05-2024	Ruben Savelkouls	Wrote some more test cases.
0.7	30-05-2024	Lotte Lakeman	Revised most test cases and added missing test cases.
0.8	30-05-2024	Ruben Savelkouls	Wrote some missing test cases.
1.0	31-05-2024	Ruben Savelkouls	Wrote the test procedure.
1.1	05-06-2024	Lotte Lakeman	Revised a significant portion of the test cases, added missing ones and revised the test procedure.
1.2	06-06-2024	Lotte Lakeman	Continued working on the test procedure and updated the traceability matrix.
1.3	10-06-2024	Diego Rivera Garrido	Updated upload tests to match new upload system, added resetting opacity, contrast, saturation, gamma and brightness tests, added tests for setting color mode.
1.3	14-06-2024	Diego Rivera Garrido	Added tests for extra requirements.
1.4	20-06-2024	Diego Rivera Garrido Lotte Lakeman	Added list of definitions and updated the ATP to reflect the desired changes of the client.
1.5	03-07-2024	Lotte Lakeman	Updated section 5

DOCUMENT CHANGE RECORDS

Version	Date	Section	Reason
0.1	24-04-2024	Entire document	Creation of the entire document.
1.0	10-06-2024	Entire document	Added all test cases and procedures.
1.1	14-06-2024	Entire document	Added test cases and procedures for some extra requirements.
1.5	03-07-2024	Section 5	Added the section.

1   INTRODUCTION

1.1   PURPOSE

This document, the ATP (Acceptance Test Plan), serves as a document which specifies the tests the clients must go over. The purpose of completing these tests is to see whether the end product, the XRF Explorer 2.0, meets the requirements specified in the URD. The test cases in this document fully cover the requirements of the URD and specify how they should be completed.

1.2   OVERVIEW

- Chapter 2 contains the test plan. In this chapter the items which need to be tested as well as the features which need to be tested are specified. Furthermore, the test deliverables are specified and given to the reader. The testing tasks and environmental needs are also mentioned. Additionally, the pass and fail criteria for a test case are defined in this chapter.

- Chapter 3 contains all test cases and their specifications. For each test case a name, a unique identifier (ID), its respective requirement(s), a precondition, and its parameters are given. Additionally, the input and output specifications are given.

- Chapter 4 contains the test procedures. The test procedures specify the logical order for completing the various test cases. Additionally, steps needed to complete the test procedures are given.

- Chapter 5 contains the test reports. This chapter serves as a referral to the relevant sections in the Software Transfer Document (STD).

- Chapter 6 contains the traceability matrix. The traceability matrix shows how each user requirement of the URD is linked to the test cases in the ATP. For each requirement, a test case and priority is specified.

- Appendix A is the signing page, where the signatures and approval of the client and supervisor can be found.

1.3   LIST OF DEFINITIONS

1.3.1   Terms

Term	Description
Clients	Ana Martins, Lars Maxfield, and Marco Roling
Color segmentation window	Visualization view that displays the distribution of color segments throughout the painting.
Contextual image	Image displaying the painting in a modality, e.g. RGB images or UV images.
Control point	A point in pixel space used to define the coordinates of a distinguished feature in an image.
Coordinate system	System to uniquely determine the position of points in space.
Data registration	The process of aligning images using (given) control points such that all the images have the same dimension and orientation.
Data source	Collection of raw, processed and contextual data that correspond to the same painting and are used to analyze said painting.

Continued on next page

Term	Description
Dialog	A dialog is a small, temporary window that appears on the screen to facilitate user interaction, often requiring user input or action before it can be dismissed.
Dimensionality reduction	Transformation of data from high-dimensional space into low-dimensional space.
Dimensionality reduction window	Window displaying the dimensionality reduction results to the user.
Dimensionality reduction window viewer	Viewer found within the dimensionality reduction window that displays the embedding.
Elemental channel window	Window that displays the elemental channels.
Elemental composition	Abundance and distribution of the elements present in the painting.
Elemental distribution map	Image derived from the processed data, visualizing the distribution of one element across the painting.
Elemental distribution view	Main viewer when the top layer of the main viewer is set to the elemental distribution map.
Element chart window	Window that displays the elemental composition across the painting as well as the selected area in the form of line/bar charts.
Elements	Chemical elements present in the painting.
Filters	Visual effects applied to a layer visible in the main viewer (includes contrast, saturation, gamma and brightness).
Processed data	Processed datacube (3-dimensional) of elemental distribution data obtained from processing the raw data that, for each pixel, gives the abundance of the different elements present.
Polygon selection tool	Selection tool which allows for creation of polygonal shapes (both for the dimensionality reduction view and the main viewer).
Raw data	Raw datacube (3-dimensional) of spectral data obtained from the XRF scanner that, for each pixel, gives the intensity of the X-ray fluorescence emitted at different energies the elements in the painting.
Layer	Discrete compound that contains an individual contextual image or elemental distribution map.
Layer window	Window in which the layer stack can be seen and edited (move, add, remove layers, change opacity and filters).
Lens	Mouse position driven ocular that looks through the top layer to a selected layer below.
Lens viewing mode	Mode in which the user controls the lens.
Recipe	A set of control points over a set of images of the painting, linked across multiple images for perspective correction and alignment to register the data.
Rectangle selection tool	Selection tool which allows for creation of rectangular shapes (both for the dimensionality reduction view.

Term	Description
Selection tool	Tool that allows the user to select a subset of the painting.
Spectra	Representation of the intensity (counts) of the fluorescence emitted by the materials in the painting as a function of energy (KeV).
Spectral window	Window of the average fluorescence spectrum acquired over the whole painting or selected area.
Toast message	Brief, temporary notification that appears on the screen to inform users of a particular event or action without requiring user interaction, typically disappearing automatically after a few seconds.
Toolbar	Tool bar located at the middle bottom of the application window, provides quick access to the selection tools, lens mode, and some main viewer settings.
(Main) Viewer	Main large interactive visualization where spatial data is presented.
Visualization views/windows	Any of the visualizations that are not the main viewer, where different plots and graphs can be displayed.

1.3.2 Acronyms and abbreviations

Term	Description
ATP	Acceptance Test Plan
URD	User Requirements Document
XRF scanner	X-ray fluorescence scanner
DRS	Dimensionality reduction system
URC	User Requirements Constraint
URF	User Requirements Functional
STD	Software Transferal Document
SDD	Software Design Document

1.4 LIST OF REFERENCES

[1] D. V. B. van Berkum, "Xrf-xplorer: An interactive visual exploration tool for micro-x-ray fluorescence scanning data on paintings," Master's thesis, Eindhoven Univerisity of Technology, September 2023.

[2] "Xrf explorer 2.0: Software transfer document," tech. rep., Eindhoven University of Technology, 2024.

2   TEST PLAN

2.1   TEST ITEMS

The software (item) to be tested is the XRF Explorer 2.0. For additional information about this software, please refer to the URD or Software Design Document (SDD).

2.2   FEATURES TO BE TESTED

The features to be tested are specified in the URD. All "must have" requirements as specified in the URD, must be implemented in the final product and must thus be tested. Any "should have" or "could have" requirements from the URD which have been implemented, will also be tested. In case a "should have" or "could have" requirement has not been implemented, it will be completely omitted from this document. "Won't have" requirements were never intended to be implemented within the scope of this project and will thus also not be tested.

2.3   TEST DELIVERABLES

To ensure being able to properly test the software, the following documents will be provided by the team to the tester prior to the testing session:

- The XRF Explorer 2.0 software;
- The ATP, chapters 1-4;
- The URD;
- An RGB image intended for testing purposes, `RGB image`;
- A UV image intended for testing purposes, `UV image`, together with its registration recipe, `UV image recipe`;
- An X-ray image intended for testing purposes, `X-ray image`, together with its registration recipe `X-ray recipe`;
- Elemental cube data intended for testing purposes, `cube`, together with its registration recipe, `cube recipe`;
- Spectral cube data intended for testing purposes, `cube`. together with its registration recipe, `cube recipe`;

After completion of the full test procedures and covering all test cases, the following documents will be delivered by the development team to the clients and course:

- A full report on any complications or issues which may have occurred during the test session;
- The full ATP containing the results of the test session.

2.4   TESTING TASKS

Prior to executing the testing procedure, the following tasks are expected to have been completed.

- Test cases are created.
- Linking test cases to the corresponding URD requirements.
- Ensuring all environmental needs are met.
- Required example files are provided for the tester.
- The server is working. This can be assumed for all test cases unless specified otherwise.

2.5 ENVIRONMENTAL NEEDS

In order to be able to execute the acceptance test, the following is required.

- The tester has a computer or laptop with either Google Chrome (version 124 or higher), or Firefox (version 125 or higher).

- The user uses one of the following operating systems based on x86-64 based architectures: Windows 10, Windows 11 or Ubuntu Server LTS 24.04.

- The tester's computer or laptop has at least 16GB of RAM.

- The tester is proficient in the English language.

- The server is functional and accessible while using the application.

2.6 TEST CASE PASS/FAIL CRITERIA

A test is considered to have passed if, after correctly following the input specification while the precondition is met, the output follows the output specification. In the case of a test's output not matching the output specification even though the input specification was followed and the precondition was met, the test shall be considered to have failed. The overall acceptance test succeeds if all the tests pass.

3   TEST CASE SPECIFICATIONS

3.1   CAPABILITY REQUIREMENTS

ATC1 Opening the "Create new data source" dialog.

Requirements	URF 3.1
Preconditions	The "Create new data source" dialog is not open.
Parameters	–

	Input specifications	Output specifications
1	Click on the "File" button in the top header.	
2		The "File" drop-down dialog is displayed.
3		The "New data source" button is displayed.
4	Click on the "New data source" button in the top header.	
5		The "Create new data source" dialog is displayed.

ATC2 Pressing the upload button without any data sources.

Requirements	URF 3.3 (partly)
Preconditions	The "Create new data source" dialog is open.
Parameters	data source name

	Input specifications	Output specifications
1	Enter data source name as the data source name and click the "Next" button.	
2		The "Create a new data source" dialog closes, the "Set up workspace data" dialog opens, and the "Save" button is disabled.
3	Click the "Save" button.	
4		Nothing happens.

ATC3 Uploading a data source.

Requirements	URF 2.1, URF 2.2, URF 2.3, URF 2.4, URF 3.2, URF 3.3, URF 3.7
Preconditions	The "Set up workspace data" dialog is open.
Parameters	RGB image, UV image, UV image recipe, elemental cube, spectral cube raw, spectral cube rpl, cube recipe, elem1

	Input specifications	Output specifications
1		The warning "Base image must have a name" appears in the bottom left.
2	Click the "Upload files" button.	
3		The "Upload files" dialog opens.
4	Click the "Choose files" button.	
5		A file browser opens.
6	Select the RGB image file, the UV image file, and the elemental cube file, the spectral cube raw and rpl files, and the respective recipe files (7 files in total), and click "Open".	
7		The file browser closes.
8	Click the yellow "Upload files" button.	
9		The files get uploaded, a loading bar appears and once it finishes loading the bar disappears.
10	Close the "Upload files" dialog by clicking the cross icon in the top right of the dialog.	
11	In the empty entry in the list, write "RGB image" in the "Name" field, and select RGB image in the "Files" field.	
12	Set the dropdown in the bottom left to "Spectral datacube" and click "Add component".	
13		A new empty entry appears in the list and the warning "Spectral cube must have a name" appears in the bottom left.
14	In the new entry, write "SPECTRAL CUBE" in the "Name" field, select spectral cube raw in the "Select a raw file" field, select spectral cube rpl in the "Select an rpl file" field, and select spectral cube recipe in the "Select a recipe file" field.	
15	Set the dropdown in the bottom left to "Elemental datacube" and click "Add component".	
16		A new empty entry appears in the list and the warning "Elemental cube must have a name" appears in the bottom left.
17	In the new entry, write "ELEMENTAL CUBE" in the "Name" field, select elemental cube in the "Select a data file" field, and select elemental cube recipe in the "Select a recipe file" field.	
18		No more warnings appear in the bottom left.
19	Set the dropdown in the bottom left to "Contextual image" and click "Add component".	

	Input specifications	Output specifications
20		A new empty entry appears in the list and the warning "Contextual image must have a name" appears in the bottom left.
21	In the new entry, write "UV image" in the "Name" field, select `UV image` in the "Select an image file" field, and select `UV image recipe` in the "Select a recipe field".	
22	Click the "Save" button.	
23		The files get added to the folder "`data source name`" and are uploaded to the server.
24		The "Set up workspace data" dialog closes automatically and the "Set up elemental channels" dialog opens.
25	Click "Select all elements", deselect `elem1`, and click "Save"	
26		The "Set up elemental channels" dialog closes and a toast with the message "Created workspace" is displayed.

ATC4 Trying to upload data sources with the same name.

Requirements	URF 3.5
Preconditions	A data source with the name `data source name` already exists and the "Create new data source" dialog is open.
Parameters	`data source name`

	Input specifications	Output specifications
1	Enter `data source name` as the name for the data source.	
2		A toast error message indicating that a data source with the name `data source name` already exists pops up.

ATC5 Viewing and accessing data sources.

Requirements	URF 3.4, URF 3.6
Preconditions	There is at least one data source. A data source with the name `data source name` exists.
Parameters	`data source name`

	Input specifications	Output specifications
1	Click on the "file" button in the top header.	
2		The "file" drop-down dialog is displayed.
3		A list of all available data sources is displayed.
4	Click on the data source called `data source name`.	
5		A toast message indicating that the data source is being loaded in pops up.
6		After the data source has finished loading in, the main viewer displays the data source.

ATC6 Upload new data to existing data sources.

Requirements	URF 3.12, 5.8
Preconditions	There is one loaded data source.
Parameters	`X-ray image`, `X-ray recipe`

	Input specifications	Output specifications
1	Click on the "View" button in the top header.	
2		The "View" drop-down dialog is displayed.
3		The "Workspace" button is displayed.
4	Click on the "Workspace" button in the top header.	
5		The "Workspace" window is displayed.
6	Click the settings icon next to the "Base image" menu item in the workspace window.	
7		The "Set up workspace data" dialog opens.
8	Click the "Upload files" button.	
9		The "Upload files" dialog opens.
10	Click the "Choose files" button.	
11		A file browser opens.
12	Select the `X-ray image` and `X-ray recipe` files and click "Open".	
13	Set the dropdown in the bottom left to "Contextual image" and click "Add component".	
14		A new empty entry appears in the list and the warning "Contextual image must have a name" appears in the bottom left.

	Input specifications	Output specifications
15	In the new entry, write "X-ray image" in the "Name" field, select X-ray image in the "Select an image file" field, and select X-ray image recipe in the "Select a recipe field".	
16	Click the "Save" button.	
17		The new files get added to the folder "data source name" and are uploaded to the server.
18		The "Set up workspace data" dialog closes automatically, the xray image gets added to the data source, a toast appears with the message "Updated workspace".

ATC7 Edit elemental channels in existing data sources.

Requirements	URF 3.10
Preconditions	There is one loaded data source with elem1 disabled, and elem2 enabled, and the workspace window is open.
Parameters	elem1, elem2

	Input specifications	Output specifications
1	Click the settings icon next to the "Generated data"/"Elemental channels" menu item in the workspace widow.	
2		The "Set up elemental channels" dialog opens.
3	Toggle elem1 to enable it.	
4	Toggle elem2 to disable it.	
5	Click the yellow "Save" button.	
6		The "Set up elemental channels" dialog closes, and a toast appears with the message "Updated workspace". The elements get updated to reflect the changes.

ATC8 Zooming in the main viewer.

Requirements	URF 6.3
Preconditions	A data source is loaded in and an image is visible in the main viewer.
Parameters	–

	Input specifications	Output specifications
1	Make a zoom-in scrolling motion while hovering over the image in the main viewer.	

	Input specifications	Output specifications
2		The image in the main viewer gets zoomed in on.
3	Make a zoom-out scrolling motion while hovering over the image in the main viewer.	
4		The image in the main viewer gets zoomed out on.

ATC9 Restricting the zoom in the main viewer.

Requirements	URF 6.16	
Preconditions	A data source is loaded in and an image is visible in the main viewer.	
Parameters	–	

	Input specifications	Output specifications
1	Make a zoom-in scrolling motion while hovering over the image in the main viewer. Zoom in as far as possible.	
2		The image in the main viewer gets zoomed in on.
3		Once the zoom limit is reached, the zoom gets clamped.
4		A toast message pops up indicating the zoom limit has been reached.
5	Make a zoom-out scrolling motion while hovering over the image in the main viewer. Zoom out as far as possible.	
6		The image in the main viewer gets zoomed out on.
7		Once the zoom limit is reached, the zoom gets clamped.
8		A toast message pops up indicating the zoom limit has been reached.

ATC10 Changing the zoom/scroll speed in the main viewer.

Requirements	URF 6.9	
Preconditions	A data source is loaded in and an image is visible in the main viewer.	
Parameters	–	

	Input specifications	Output specifications
1	Navigate to the toolbar in the bottom middle of the screen.	

Input specifications	Output specifications
2 Press the settings icon.	
3	The toolbar settings pop-up window opens.
4 Use the scroll speed slider and change the scroll speed.	
5	The scroll speed slider in the settings menu displays the new scroll speed value.
6	In the main viewer, the scroll speed is changed to the new zoom speed value.

ATC11 Panning in the main viewer.

Requirements	URF 6.4
Preconditions	A data source is loaded in and an image is visible in the main viewer.
Parameters	–

Input specifications	Output specifications
1 Hover over the main viewer, click on the image and drag it to pan in the viewer.	
2	The image in the main viewer is panned in the user-specified direction.

ATC12 Changing the movement speed in the main viewer.

Requirements	URF 6.10
Preconditions	A data source is loaded in and an image is visible in the main viewer.
Parameters	–

Input specifications	Output specifications
1 Navigate to the toolbar in the bottom middle of the screen.	
2 Press the settings icon.	
3	The toolbar settings pop-up window opens.
4 Use the movement speed slider and change the movement speed.	
5	The movement speed slider in the settings menu displays the new movement speed value.
6	In the main viewer, the movement speed is changed to the new movement speed value.

ATC13 Opening the dimensionality reduction window.

Requirements	URF 15.1
Preconditions	A data source has been loaded in and the dimensionality reduction window is not open.
Parameters	–

	Input specifications	Output specifications
1	Click on the "View" button in the top header.	
2		The "View" drop-down menu is displayed.
3		The "Dimensionality reduction" button is displayed.
4	Click on the "Dimensionality reduction" button in the top header.	
5		The "Dimensionality reduction" view is displayed.

ATC14 Dimensionality reduction set-up

Requirements	URF 15.2, URF 15.3, URF 15.4, URF 15.5, URF 15.6, URF 15.7
Preconditions	A data source has been loaded and the dimensionality reduction window is open.
Parameters	element

	Input specifications	Output specifications
1	Select element in the "Element" select menu.	
2	Set the threshold for the dimensionality reduction in the "Threshold" adjusting menu.	
3	Click the "Generate embedding" button.	
4		"Generating" is displayed in the DR window viewer.
5		"Please select an overlay" is displayed in the DR window viewer.

ATC15 Visualizing the average spectrum of the whole painting.

Requirements	URF 6.2, URF 14.1
Preconditions	A data source has been loaded in and the "Spectrum" window is not open.
Parameters	–

	Input specifications	Output specifications
1	Press the "View" button.	
2		The "View" drop-down window opens.
3	Press the "Spectrum" button.	
4		The "View" drop-down window closes.
5		The "Spectrum" window opens.
6	Select the "Global average" check-box in the "Spectrum" window.	
7		A spectrum chart over the whole painting is displayed in the "Spectrum" window.

ATC16 Visualizing theoretical emission energies of elements in the spectra.

Requirements	URF 14.3, 14.4
Preconditions	A data source has been loaded in, `elem1` is enabled, and the spectrum window is open.
Parameters	`elem1`

	Input specifications	Output specifications
1	Select the "Element theoretical" check-box in the "Spectrum" window, choose `elem1` in the "Choose element for theoretical spectrum" dropdown, and set the excitation energy to 100.	
2		The theoretical emission of `elem1` is visualized in the chart.

ATC17 Visualizing the average abundance of elements over the whole painting as a bar chart

Requirements	URF 11.1, URF 11.2
Preconditions	A data source is loaded in and the charts window is not open.
Parameters	–

	Input specifications	Output specifications
1	Press the "View" button.	
2		The "View" drop-down window opens.
3	Press the "Elemental charts" button.	
4		The "View" drop-down window closes.

Input specifications	Output specifications
5	The "Elemental charts" window opens.
6	A bar chart of the average elemental intensity over the whole painting is displayed in the "Elemental charts" window.

ATC18 At least two visualization views open at the same time.

Requirements	URF 8.1
Preconditions	A data source is loaded in and at least two visualization views are open.
Parameters	–

Input specifications	Output specifications
1	The opened visualization views are visible in the browser.
2	The opened visualization views worked as intended per their requirements.

ATC19 Selecting a rectangle in the main viewer.

Requirements	URF 9.1, URF 9.4, URF 9.5
Preconditions	A data source has been loaded in.
Parameters	–

	Input specifications	Output specifications
1	Navigate to the toolbar in the bottom middle of the screen.	
2	Press the rectangle selection icon.	
3		The rectangle selection tool is enabled.
4	Click on a point on the image in the main viewer.	
5	Drag the cursor to a different point on the image in the main viewer.	
6	Let go on this point.	
7		The rectangular selection is highlighted in the main viewer.

ATC20 Viewing the line chart according to the active selection.

Requirements	URF 8.2 (partly), URF 8.3 (partly), URF 11.4, URF 11.6, URC 3.4
Preconditions	A data source is loaded in and a selection has been made. The chart window is open and the line chart has been enabled.
Parameters	–

	Input specifications	Output specifications
1		The line chart in the chart window is updated to show the average elemental abundance of the selected region.

ATC21 Adjusting the spectrum according to the active selection.

Requirements	URF 8.2 (partly), URF 8.3 (partly), URF 9.3, URF 14.2, URC 3.4	
Preconditions	A data source is loaded in and a selection has been made. The spectrum window is open.	
Parameters	–	

	Input specifications	Output specifications
1	Select the "Selection average" button in the spectrum window.	
2		The spectrum in the spectrum window is updated to show the average spectrum of the selected region.

ATC22 Changing selection mode.

Requirements	URF 9.7	
Preconditions	A data source is selected in and the `mode 1` selection mode is active.	
Parameters	`mode 1, mode 2`	

	Input specifications	Output specifications
1	Navigate to the toolbar in the bottom middle of the screen.	
2	Press the `mode 2` selection icon.	
3		The `mode 2` selection mode is enabled.

ATC23 Creating a polygon selection in the main viewer.

Requirements	URF 9.6	
Preconditions	A data source has been loaded in and the polygon selection mode is active.	
Parameters	–	

	Input specifications	Output specifications
1	Click on a point on the image in the main viewer.	

	Input specifications	Output specifications
2	Move the cursor to a different point on the image in the main viewer.	
3	Click on this point.	
4	Repeat steps 1 through 3 until the selected region has taken on the desired shape.	
5		The selection is highlighted in the main viewer.

ATC24 Clearing a selection in the main viewer.

Requirements   URF 9.8

Preconditions   A data source has been loaded in and a selection has been made.

Parameters   –

	Input specifications	Output specifications
1	Navigate to the toolbar in the bottom middle of the screen.	
2	Press the "Clear selection" button.	
3		The selection is cleared and is no longer highlighted in the main viewer.

ATC25 Opening and using the channels window

Requirements   URF 10.1, URF 10.5

Preconditions   A data source has been loaded in. The elemental layer is enabled. The elemental channel window is not open.

Parameters   –

	Input specifications	Output specifications
1	Press the "View" button.	
2		The "View" drop-down window opens.
3	Press the "Elemental channels" button.	
4		The "View" drop-down window closes.
5		The "Elemental channels" window opens.
6	Press the closed eye icon of any element to select it.	
7		The eye icon changes to open.

	Input specifications	Output specifications
8		The elemental distribution map of the element is visible in the "Elemental channels" window.
9		The areas in which the element is present are highlighted, based on the elemental intensity, in the elemental layer.

ATC26 Selecting a highlight color for the elemental distribution view.

Requirements	URF 10.4
Preconditions	A data source has been loaded in and the elemental channels window is opened. There is at least one element which has been selected.
Parameters	–

	Input specifications	Output specifications
1	Click on the white button next to the open eye icon (the color-picker button).	
2		A window for changing the color opens up.
3	Choose a color other than white.	
4		The color-picker button and border of the element change in color to the color chosen by the user.
5		In the main viewer, the highlighted areas belonging to the element change from white to the color chosen by the user.

ATC27 Selecting multiple elements to be highlighted simultaneously.

Requirements	URF 10.2, URF 10.3, URF 10.6
Preconditions	A data source has been opened and the elemental channels window is opened.
Parameters	–

	Input specifications	Output specifications
1	Press the closed eye icon of any element to select it.	
2		The eye icon changes to open.
3		The details of the element are visible in the "Elemental channels" window.
4		In the main viewer, the areas in which the element is present are highlighted, based on the elemental intensity.

	Input specifications	Output specifications
5	(Optional) change the color of the highlighting color by completing test case ATC26	
6	Repeat step 1 (and optionally 5) until there are four elements selected simultaneously.	
7		In the main viewer, the areas in which any of the four elements are present are highlighted, based on elemental intensity. For areas in which multiple elements are present, the highlight color is a combination of the colors chosen by the user.
8		In the bar chart window and spectrum window, the selected elements are highlighted.

ATC28 Selecting an intensity for the elemental distribution view.

Requirements	URF 10.8, 10.9, 10.10
Preconditions	A data source has been loaded in and the elemental channels window is opened. There are at least two elements which have been selected.
Parameters	–

	Input specifications	Output specifications
1	Use the intensity threshold slider to change the intensity threshold for the enabled element.	
2		The intensity threshold slider in the elemental channels window displays the new intensity threshold value.
3		In the main viewer, the highlighted area is updated in accordance with the newly selected intensity for the element and its abundance.
4	Repeat step 1 for all enabled elements.	

ATC29 Deselecting elements from the elemental distribution view.

Requirements	URF 10.7
Preconditions	A data source has been loaded in and the elemental channels window is opened. There is at least one element which has been selected.
Parameters	–

	Input specifications	Output specifications
1	Press the open eye icon of any element to deselect it.	
2		The eye icon changes to closed.

Input specifications	Output specifications
3	The details of the element are hidden in the "Elemental channels" window.
4	In the main viewer, the areas in which the element is present are de-highlighted.

ATC30 Opening the layers window

Requirements	URF 5.1
Preconditions	A data source has been loaded in and the layers window is not open.
Parameters	–

	Input specifications	Output specifications
1	Press the "View" button.	
2		The "View" drop-down window opens.
3	Press the "Layers" button.	
4		The "View" drop-down window closes.
5		The "Layers" window opens.

ATC31 Disabling a layer

Requirements	URF 5.5 (partly), URF 5.6, URC 3.2
Preconditions	A data source has been loaded in and the layers window is open. There is at least one layer enabled.
Parameters	`layer`

	Input specifications	Output specifications
1	In the layers window, click on the open eye icon of the `layer`.	
2		The eye icon changes to closed.
3		The details of `layer` are hidden in the layers window.
4		In the main viewer, `layer` is hidden.

ATC32 Enabling a layer

Requirements	URF 5.5 (partly), URC 3.1
Preconditions	A data source has been loaded in and the layers window is open.
Parameters	`layer`

	Input specifications	Output specifications
1	In the layers window, click on the closed eye icon of `layer`.	
2		The eye icon changes to open.
3		The details of `layer` are visible in the layers window.
4		In the main viewer, `layer` is visible.

ATC33 Renaming a layer

Requirements	URF 5.9
Preconditions	A data source has been loaded in, the layers window and workspace window are open.
Parameters	`image, new name`

	Input specifications	Output specifications
1	Press the settings icon next to the `image` title in the workspace window.	
2		The "Set up workspace data" dialog opens.
3	Change the name of `image` to `new name`.	
4	Press the "Save" button.	
5		The The "Set up workspace data" dialog closes.
6		A toast message indicating that the changes were successfully changed pops up.
7		The name of the image changes to `new name` in the workspace window.
8		The name of the layer changes to `new name` in the layers window.
9		A toast message indicating that saving the workspace was successful pops up.
10		The workspace is reloaded.

ATC34 Changing the layer hierarchy

Requirements	URF 5.2, URF 5.4 (partly)
Preconditions	A data source has been loaded in and the layers window is opened. `layer1` and `layer2` are enabled.
Parameters	`layer1, layer2`

	Input specifications	Output specifications
1	Click on `layer1` and hold it to drag it.	
2	Drag `layer1` above `layer2`.	
3		The layer hierarchy in the layers window displays the new order with `layer1` above `layer2`.
4		The main viewer displays the new layer hierarchy; `layer1` is visible in the main viewer.

ATC35 Visualize contextual images.

Requirements	URF 6.1
Preconditions	A data source with an RGB and/or a UV image is loaded in. In the main viewer, the RGB and/or UV image is visible.
Parameters	–

	Input specifications	Output specifications
1		The RGB and/or UV contextual image is displayed in the main viewer.

ATC36 Changing the contrast

Requirements	URF 6.5
Preconditions	A data source has been loaded in and the layers window is opened. `layer` is enabled.
Parameters	`layer`

	Input specifications	Output specifications
1	Use the contrast slider and change the contrast of `layer`.	
2		`layer`'s contrast slider in the "Layers" menu displays the new contrast value.
3		The main viewer displays `layer` in the contrast chosen by the user.

ATC37 Changing the saturation

Requirements	URF 6.6
Preconditions	A data source has been loaded in and the layers window is opened. `layer` is enabled.
Parameters	`layer`

	Input specifications	Output specifications
1	Press the "Additional sliders" button of `layer` in the layer window.	
2		The "Additional sliders" window opens.
3	Use the saturation slider and change the saturation of `layer`.	
4		`layer`'s saturation slider in the "Layers" menu displays the new saturation value.
5		The main viewer displays `layer` in the saturation chosen by the user.

ATC38 Changing the brightness

Requirements	URF 6.7
Preconditions	A data source has been loaded in and the layers window is opened. `layer` is enabled.
Parameters	`layer`

	Input specifications	Output specifications
1	Press the "Additional sliders" button of `layer` in the layer window.	
2		The "Additional sliders" window opens.
3	Use the brightness slider and change the brightness of `layer`.	
4		`layer`'s brightness slider in the "Layers" menu displays the new brightness value.
5		The main viewer displays `layer` in the brightness chosen by the user.

ATC39 Changing the gamma correction

Requirements	URF 6.8
Preconditions	A data source has been loaded in and the layers window is opened. `layer` is enabled.
Parameters	`layer`

	Input specifications	Output specifications
1	Press the "Additional sliders" button of `layer` in the layer window.	
2		The "Additional sliders" window opens.

	Input specifications	Output specifications
3	Use the gamma slider and change the gamma correction of `layer`.	
4		`layer`'s gamma slider in the "Layers" menu displays the new gamma value.
5		The main viewer displays `layer` in the gamma chosen by the user.

ATC40 Resetting filters to the original value

Requirements	URF 6.17
Preconditions	A data source has been loaded in and the layers window is opened. `layer` is enabled, and the saturation, contrast, brightness and gamma values are not the default values. The "Additional sliders" window is open.
Parameters	`layer`

	Input specifications	Output specifications
1	Double click the saturation slider.	
2		The main viewer displays `layer` in the default saturation value.
3	Double click the contrast slider.	
4		The main viewer displays `layer` in the default contrast value.
5	Double click the brightness slider.	
6		The main viewer displays `layer` in the default brightness value.
7	Double click the gamma slider.	
8		The main viewer displays `layer` in the default gamma value.

ATC41 Changing a layer's opacity

Requirements	URF 5.3, URF 5.4 (partly), URF 5.10, URF 6.11 (partly)
Preconditions	A data source has been loaded in and the layers window is opened. `layer1` and `layer2` are enabled.
Parameters	`layer1, layer2`

	Input specifications	Output specifications
1	Use the opacity slider and change the opacity of `layer1`.	

	Input specifications	Output specifications
2		`layer1`'s opacity slider in the layers menu displays the new opacity value.
3		The main viewer displays `layer1` in the opacity chosen by the user. Depending on the opacity of `layer1`, `layer2` is also displayed in the main viewer.
4	The user double clicks on `layer1`'s opacity slide.	
5		`layer1`'s opacity goes back to its original value

ATC42 Enabling the lens

Requirements	URF 12.4
Preconditions	A data source has been loaded in.
Parameters	–

	Input specifications	Output specifications
1	Navigate to the toolbar in the bottom middle of the screen.	
2	Press the lens icon.	
3		The lens mode is enabled.

ATC43 Choosing a layer for the lens

Requirements	URF 12.3
Preconditions	A data source has been loaded in and the lens mode has been enabled. `layer1` and `layer2` are enabled and `layer1` is above `layer2` in the layer hierarchy.
Parameters	`layer1, layer2`

	Input specifications	Output specifications
1	In the layers window, for `layer1` click the "Only visible inside lens" checkbox.	
2		The checkbox in the layers window updates.
3		In the main viewer outside the lens, `layer1` is no longer visible.
4		In the main viewer in the lens, `layer1` is visible.

ATC44 Moving the lens inside the main viewer.

Requirements	URF 12.2
Preconditions	A data source has been loaded in and the lens mode has been enabled. `layer` has been selected to be visible inside the lens.
Parameters	`layer`

	Input specifications	Output specifications
1	Hover the cursor around in the main viewer.	
2		`layer` is visible inside the lens.

ATC45 Locking the lens inside the main viewer.

Requirements	URF 12.6
Preconditions	A data source has been loaded in and the lens mode has been enabled. `layer` has been selected to be visible inside the lens.
Parameters	`layer`

	Input specifications	Output specifications
1	Right click in the main viewer.	
2	Hover the cursor around in the main viewer.	
3		`layer` is visible inside the lens and the lens stays in the position which the user right clicked on.

ATC46 Moving the lens outside the main viewer.

Requirements	URF 12.1
Preconditions	A data source has been loaded in and the lens mode has been enabled. `layer` has been selected to be visible inside the lens, and is above all other enabled layers.
Parameters	`layer`

	Input specifications	Output specifications
1	Hover the cursor around outside the main viewer.	
2		The lens does not move outside of the main viewer.

ATC47 Changing the lens size.

Requirements	URF 12.7	
Preconditions	A data source has been loaded in and the lens mode has been enabled. layer has been selected to be visible inside the lens and is the top layer.	
Parameters	layer	

	Input specifications	Output specifications
1	Navigate to the toolbar in the bottom middle of the screen.	
2	Press the settings icon.	
3		The toolbar settings pop-up window opens.
4	Use the lens size slider and change the lens size.	
5		The lens size slider in the settings menu displays the new lens size value.
6		In the main viewer, the lens size is changed to the new lens size value.

ATC48 Changing lens opacity.

Requirements	URF 12.9	
Preconditions	A data source has been loaded in, the "Layers" window is open.	
Parameters	layer	

	Input specifications	Output specifications
1	In the "Layers" window, for layer click the "Only visible inside lens" checkbox, and enable the lens.	
2	Change the opacity of layer.	
3		The opacity of the lens changes accordingly.

ATC49 Disabling the lens

Requirements	URF 12.5	
Preconditions	A data source has been loaded in.	
Parameters	–	

	Input specifications	Output specifications
1	Navigate to the toolbar in the bottom middle of the screen.	
2	Press the lens icon.	
3		The lens mode is disabled.

ATC50 Checking registration of contextual images.

Requirements	URF 4.1
Preconditions	A data source with an RGB and a x-ray image is loaded in. The RGB and x-ray layers are enabled, with the RGB layer on top.
Parameters	–

	Input specifications	Output specifications
1		The RGB image is displayed in the main viewer.
2	Decrease the RGB layer's opacity to 50%.	
3		Both the RGB and x-ray images are now visible in the viewer, it can be seen that both are registered to the same coordinate system.

ATC51 Showing image overlay on top of embedding from dimensionality reduction

Requirements	URF 16.1, URF 16.2, URF 16.3
Preconditions	A data source has been loaded in, the dimensionality reduction window is open, and an embedding has finished generating for the current data source.
Parameters	–

	Input specifications	Output specifications
1	Select "UV" in the "Overlay" select menu button.	
2		"Loading" is displayed in the DR window viewer.
3		The previously generated embedding with the UV overlay is displayed in the DR window viewer.
4	Repeat from step 1 for the "RGB" and "xray" overlays.	

ATC52 Showing intensity overlay on top of embedding from dimensionality reduction

Requirements	URF 16.1, 16.3, 16.7
Preconditions	A data source has been loaded in, the dimensionality reduction window is open, and an embedding has finished generating for the current data source.
Parameters	–

	Input specifications	Output specifications
1	Select an element in the "Overlay" select menu in the DR window.	
2		"Loading" is displayed in the DR window viewer.

Input specifications	Output specifications
3	The previously generated embedding with the elemental intensity overlay is displayed in the DR window viewer.

ATC53 Using the dimensionality reduction polygon selection tool

Requirements	URF 16.4, URF 16.5
Preconditions	A data source has been loaded in, the dimensionality reduction window is open, and an embedding has finished generating for the current data source.
Parameters	–

	Input specifications	Output specifications
1	Press the polygon selection tool icon in the dimensionality reduction window.	
2		The polygon selection tool is enabled in the dimensionality reduction window.
3	Click on a point on the generated image in the dimensionality reduction window.	
4	Move the cursor to a different point on the generated image in the dimensionality reduction window.	
5	Click on this point.	
6	Repeat steps 3 through 5 until the selected region has taken on the desired shape.	
7		The selection is highlighted in the dimensionality reduction window.
8		The areas corresponding to the selected area in the dimensionality reduction, are highlighted in the main viewer.

ATC54 Using the dimensionality reduction rectangle selection tool

Requirements	URF 16.8, URF 16.9
Preconditions	A data source has been loaded in, the dimensionality reduction window is open, and an embedding has finished generating for the current data source.
Parameters	–

	Input specifications	Output specifications
1	Press the rectangle selection tool icon in the dimensionality reduction window.	

	Input specifications	Output specifications
2		The rectangle selection tool is enabled in the dimensionality reduction window.
3	Click and hold on a point on the generated image in the dimensionality reduction window.	
4	While holding down the mouse click, move the cursor to a different point on the generated image in the dimensionality reduction window.	
5	Let go on this point.	
6		The selection is highlighted in the dimensionality reduction window.
7		The areas corresponding to the selected area in the dimensionality reduction, are highlighted in the main viewer.

ATC55 Selecting a highlight color for the dimensionality reduction.

Requirements	URF 16.12
Preconditions	A data source has been loaded in, the dimensionality reduction window is open, and an embedding has finished generating for the current data source. A selection has been made in the dimensionality reduction window.
Parameters	–

	Input specifications	Output specifications
1	Click on the white button next to the polygon selection tool (the color-picker button).	
2		A window for changing the color opens up.
3	Choose a color other than white and click "Select".	
4		The color-picker button changes in color to the color chosen by the user.
5		In the main viewer, the highlighted areas belonging to the dimensionality reduction selection change from white to the color chosen by the user.

ATC56 Opening the Color segmentation window.

Requirements	URF 13.2
Preconditions	A data source has been loaded in and the Color segmentation window is not open.
Parameters	–

	Input specifications	Output specifications
1	Press the "View" button.	
2		The "View" drop-down window opens.
3	Press the "Color segmentation window" button.	
4		The "View" drop-down window closes.
5		The "Color segmentation window" opens.
6		In the color segmentation window an element selection menu, a threshold selection menu and a number of clusters selection menu appears.
7	Select "Complete painting" in the "Select an element" dropdown and set "Number of clusters" to 15 and click "Generate color clusters".	
8		A "Loading" message appears in the window.
9		In the color segmentation window, 15 colors corresponding to the color segmentation of the complete painting are visible.

ATC57 Viewing the color segmentation per element.

Requirements	URF 13.1, 13.8
Preconditions	A data source has been loaded in and the color segmentation window is opened.
Parameters	–

	Input specifications	Output specifications
1	Select any element from the element selection menu button, set "Threshold" to 50%, set "Number of clusters" to 25 and click "Generate color clusters".	
2		In the color segmentation window, 25 colors corresponding to the color segmentation of the regions of the painting where the concentration of the selected element is above 50% are visible.

ATC58 Selecting a color from color segmentation from a specific element.

Requirements	URRF 13.3, 13.4, 13.9
Preconditions	A data source has been loaded in and the color segmentation window is opened. An element (or the complete painting) has been chosen for the color segmentation window.
Parameters	–

	Input specifications	Output specifications
1	In the color segmentation window, click on any color.	
2		In the main viewer, the pixels in which the selected color is present, are highlighted.

ATC59 Selecting multiple colors from color segmentation.

Requirements	URF 13.7
Preconditions	A data source has been loaded in and the color segmentation window is opened. An element (or the complete painting) has been chosen for the color segmentation window.
Parameters	–

	Input specifications	Output specifications
1	In the color segmentation window, click on any color.	
2		In the main viewer, the pixels in which the selected color is present, are highlighted.
3	Repeat step 1 until at least four colors have been selected.	
4		In the main viewer, the pixels belonging to any of the colors are highlighted.

ATC60 Exporting the main viewer.

Requirements	URF 7.1
Preconditions	A data source has been loaded in.
Parameters	–

	Input specifications	Output specifications
1	Press the "Export" button.	
2		The "Export" drop-down window opens.
3	Press the "Painting" button.	
4		The "Export" down-down window closes.
5		A toast message indicating that the export has started pops up.
6		The main viewer gets saved as a PNG to the user's standard download location.

ATC61 Exporting a visualization view.

Requirements	URF 7.2
Preconditions	A data source has been loaded in and the `window` window is open or mini-mized.
Parameters	`window`

	Input specifications	Output specifications
1	Press the "Export" button.	
2		The "Export" drop-down window opens.
3	Press the `window` button.	
4		The "Export" down-down window closes.
5		A toast message indicating that the export has started pops up.
6		The `window` gets saved as a JPEG to the user's standard download location.

ATC62 Enabling the second main viewer.

Requirements	URF 6.12
Preconditions	A data source has been loaded in and only one main viewer is enabled.
Parameters	–

	Input specifications	Output specifications
1	Click on the "View" button in the top header.	
2		The "View" drop-down menu is displayed.
3		The "Second main viewer" button is displayed.
4	Click on the "Second main viewer" button in the top header.	
5		After loading, a toast message pops up stating "Viewer layout updated".
6		Two main viewers are visible in the centre of the application.

ATC63 Zooming and panning with two main viewers.

Requirements	URF 6.15
Preconditions	A data source has been loaded in and two main viewers are enabled.
Parameters	–

	Input specifications	Output specifications
1	Perform ATC8 in the left main viewer.	
2		In the left main viewer, the zoom is applied.
3		In the right main viewer, the zoom is not applied.
4	Perform ATC8 in the right main viewer.	
5		In the right main viewer, the zoom is applied.
6		In the left main viewer, the zoom is not applied.
7	Perform ATC11 in the left main viewer.	
8		In the left main viewer, the pan is applied.
9		In the right main viewer, the pan is not applied.
10	Perform ATC11 in the right main viewer.	
11		In the right main viewer, the pan is applied.
12		In the left main viewer, the pan is not applied.

ATC64 Using synchronized lens across two main viewers.

Requirements	URF 12.8
Preconditions	A data source has been loaded in and two main viewers are enabled. The layers window is open.
Parameters	`layer`

	Input specifications	Output specifications
1	Perform ATC42 in both main viewers.	
2		The lens is enabled in both viewers.
3	In the layers window, for `layer` click the "Only visible in lens" checkbox, set the layer to the top.	
4	Double click in both viewers to reset the zoom.	
5	Perform ATC44 in the left main viewer.	
6		In the left main viewer, the lens is visible on the mouse.
7		In the right main viewer, the lens is visible on the same areas.

ATC65 Changing the application's color theme

Requirements	URF 18.1
Preconditions	The application is open.
Parameters	`theme`

	Input specifications	Output specifications
1	Press the "XRF-Explorer" button on the top left.	
2		A drop-down window opens.
3	Press the `theme` mode.	
4		The drop-down closes and the application's theme changes to `theme`.

ATC66 Changing the application's color theme to use the system default

Requirements	URF 18.1
Preconditions	The application is open.
Parameters	-

	Input specifications	Output specifications
1	Press the "XRF-Explorer" button on the top left.	
2		A drop-down window opens.
3	Press the "Automatic mode" button.	
4		The drop-down closes and the application's theme changes to the system's default.

ATC67 Deleting a data source.

Requirements	URF 3.9
Preconditions	A data source has been loaded in and the workspace window is open.
Parameters	`data source name`

	Input specifications	Output specifications
1	Click the "Delete project" button.	
2		A confirmation dialog pops up asking the user to confirm that the current data source should be deleted.
3	(Optional) check the "Also delete all associated files" checkbox.	
4	Click the "Delete" button to confirm.	
5		A toast message indicating that the deletion process was successful pops up.
6		The data source closes.

	Input specifications	Output specifications
7	Perform ATC5 steps 1-3.	
8		The data source with the name `data source name` is not visible in the list of available data sources.

3.2 CONSTRAINT REQUIREMENTS

ATC68 Test running application locally.

Requirements	URC 2.3
Preconditions	User has Windows 10/11 or Ubuntu Server LTS 24.04 installed, the source code downloaded, and the dependencies installed as defined in the `README.md` file. User has a terminal open in the source code directory.
Parameters	-

	Input specifications	Output specifications
1	Navigate to `/xrf_explorer/client`.	
2	Compile frontend code with `npm run build`.	
3	Navigate to / and run `python run.py`.	
4	Open a supported web browser and navigate to `http://127.0.0.1:8001`.	
5		The web-app loads and runs.

4   TEST PROCEDURES

In accordance with constraint requirements URC 2.1 and 2.2, the test procedures below should be carried out with either Chrome version 124 or higher, or Firefox version 125 or higher. Additionally, in accordance with constraint requirement URC 2.5, the test procedures below should be carried out on a computer screen. Moreover, a computer screen should be use in accordance with URC 2.5.

TP1 Uploading data sources

Purpose	This test procedure is for testing the uploading and accessing of data sources.
Notes	-

Step	Procedure steps	Parameters
1	Perform ATC1.	–
2	Perform ATC2.	`data source name: ATP_20240619`

3	Perform ATC3.	`RGB image: base.png`
		`UV image: uv.png`
		`UV image recipe: recipe_uv.csv`
		`elemental cube: elemental.dms`
		`spectral cube raw: spectral.raw`
		`spectral cube rpl: spectral.rpl`
		`cube recipe: recipe_cube.csv`
		`elem1: Si K`

4	Perform ATC1.	`data source name: ATP_20240619`
5	Perform ATC4.	–
6	Perform ATC5	`data source name: ATP_20240619`

TP2 Editing data sources

Purpose	This test procedure is for testing the editing of existing data sources.
Notes	-

Step	Procedure steps	Parameters
1	Perform ATC6.	`X-ray image: xray.png` `X-ray recipe: recipe_xray.csv`
2	Perform ATC7.	`elem1: Si K` `elem2: P K`

TP3 Main viewer

Purpose	This test procedure is for testing basic features related to the main viewer.
Notes	-

Step	Procedure steps	Parameters
1	Perform ATC8.	–
2	Perform ATC9.	–
3	Perform ATC10.	–
4	Perform ATC11.	–
5	Perform ATC12.	–

TP4 Starting dimensionality reduction

Purpose	This test procedure is for starting the dimensionality reduction process.
Notes	As the generation is not instantaneous, the dimensionality reduction process is started early on such that it can be ready at the end of the test plan.

Step	Procedure steps	Parameters
1	Perform ATC13.	–
2	Perform ATC14.	`element:  Zn K`
3	(Optional) minimize the dimensionality reduction window.	–

TP5 Linking visualization viewers, making a selection and viewing the bar, line and spectrum charts.

Purpose	This test procedure is for opening all chart visualization windows, seeing how they are linked to each other and also the active selection.
Notes	-

Step	Procedure steps	Parameters
1	Perform ATC15.	–
2	Perform ATC16.	`elem1:  Si K`
3	Perform ATC17.	–
4	Perform ATC18.	–
5	In the "Elemental charts" window, check the "Line chart" checkbox.	–
6	Perform ATC19.	–
7	Perform ATC20.	–
8	Perform ATC21.	–
9	Perform ATC22.	`mode 1:  rectangle` `mode 2:  polygon`

Step	Procedure steps	Parameters
10	Perform ATC23.	–
11	Perform ATC20.	–
12	Perform ATC21.	–
13	Perform ATC24.	–

TP6 Elemental channels

Purpose	This test procedure is for all test cases related to the elemental channels window.
Notes	Test casesATC20, and ATC21 should be done after each step in this test procedure. This involves no additional actions from the user, as these test cases are about charts being updated automatically.

Step	Procedure steps	Parameters
1	Perform ATC25.	–
2	Perform ATC26.	–
3	Perform ATC27.	–
4	Perform ATC28.	–
5	Perform ATC29 and repeat until all elements have been deselected.	–
6	(Optional) minimize the chart, channels, and spectrum windows.	

TP7 Layers and the lens

Purpose	This test procedure is for all test cases related to the layers window and the lens tool.
Notes	-

Step	Procedure steps	Parameters
1	Perform ATC30.	–
2	Perform ATC31.	layer: Elemental maps
3	Perform ATC32.	layer: UV image
4	Perform ATC33.	image: RGB new name: RGB image
5	(Optional) minimize the workspace window.	–
6	Perform ATC34.	layer1: RGB image layer2: UV image

Step	Procedure steps	Parameters
7	Perform ATC35.	–
8	Perform ATC36.	`layer: RGB image`
9	Perform ATC37.	`layer: RGB image`
10	Perform ATC38.	`layer: RGB image`
11	Perform ATC39.	`layer: RGB image`
12	Perform ATC40.	`layer: RGB image`
13	Perform ATC41.	`layer1: RGB image` `layer2: UV image`
14	Perform ATC42.	–
15	Perform ATC43.	`layer1: RGB image` `layer2: UV image`
16	Perform ATC44.	`layer: RGB image`
17	Perform ATC45.	`layer: RGB image`
18	(Optional) right-click in the main viewer to unlock the lens.	–
19	Perform ATC46.	`layer: RGB image`
20	Perform ATC47.	`layer: RGB image`
21	Perform ATC48.	`layer: RGB image`
22	Perform ATC49.	–
23	(Optional) minimize the layers window.	–

TP8 Generated dimensionality reduction

Purpose	This test procedure is for all test cases related to when the dimensionality reduction has finished generating.
Notes	-

Step	Procedure steps	Parameters
1	(Optional) maximize the dimensionality reduction window.	–
2	Perform ATC14 step 8.	`overlay: RGB image` `element: Zn K`
3	Perform ATC51.	–
4	Perform ATC52.	–
5	Perform ATC53.	–
6	Perform ATC54.	–

Step	Procedure steps	Parameters
7	Perform ATC55.	–
8	(Optional) minimize the dimensionality reduction window.	–

TP9 Color segmentation

Purpose	This test procedure is for all test cases related to the color segmentation window.
Notes	-

Step	Procedure steps	Parameters
1	Perform ATC56.	–
2	Perform ATC57.	–
3	Perform ATC58.	–
4	Perform ATC59.	–
5	(Optional) minimize the color segmentation window.	–

TP10 Exporting windows

Purpose	This test procedure is for all test cases related to exporting windows.
Notes	-

Step	Procedure steps	Parameters
1	Perform ATC60.	–
2	Perform ATC61 and repeat the test case for all parameters options.	window: Elements window: Embedding window: Spectral

TP11 Using two main viewers

Purpose	This test procedure is for all test cases related to using two main viewers.
Notes	-

Step	Procedure steps	Parameters
1	Perform ATC62.	–
2	Perform ATC63.	–

Step	Procedure steps	Parameters
3	Perform ATC64.	layer: RGB image
4	(Optional) disable the second main viewer.	–

TP12 Changing the application's color theme

Purpose	This test procedure is for all test cases related to changing the application's color theme.
Notes	-

Step	Procedure steps	Parameters
1	Perform ATC65.	theme: dark mode
2	Perform ATC66.	–

TP13 Deleting the test data source

Purpose	This procedure is the final procedure and allows the user to delete the test data source.
Notes	-

Step	Procedure steps	Parameters
1	(Optional) maximize the workspace window.	–
2	Perform ATC67.	data source name: ATP_20240619
3	(Optional) minimize the workspace window.	–

TP14 Testing constraint requirements

Purpose	This test procedure is for all test cases related to the (testable) constraint requirements.
Notes	-

Step	Procedure steps	Parameters
1	Perform ATC68.	

5   TEST REPORTS

The test report can be found in section 5 of the Software Transfer Document (STD) [2].

6   TRACEABILITY MATRIX

6.1   CAPABILITY REQUIREMENTS

6.1.1   Requirements for user roles and accounts

Requirement ID	Test case	Priority
URF 1.1	Won't have	**W**
URF 1.2	Won't have	**W**
URF 1.3	Won't have	**W**
URF 1.4	Won't have	**W**

6.1.2   Requirements for loading data

Requirement ID	Test case	Priority
URF 2.1	ATC3	**M**
URF 2.2	ATC3	**M**
URF 2.3	ATC3	**M**
URF 2.4	Not implemented	**S**

6.1.3   Requirements for data sources

Requirement ID	Test case	Priority
URF 3.1	ATC1	**M**
URF 3.2	ATC3	**M**
URF 3.3	ATC2, ATC3	**M**
URF 3.4	ATC5	**M**
URF 3.5	ATC4	**M**
URF 3.6	ATC5	**S**
URF 3.7	ATC3	**S**
URF 3.8	Not implemented	**S**
URF 3.9	ATC67	**S**
URF 3.10	ATC7	**C**
URF 3.11	Not implemented	**C**

Requirement ID	Test case	Priority
URF 3.12	ATC6	C
URF 3.13	Not implemented	C

6.1.4   Requirements for processing data

Requirement ID	Test case	Priority
URF 4.1	ATC50	M
URF 4.2	Not implemented	C

6.1.5   Requirements for the layer system

Requirement ID	Test case	Priority
URF 5.1	ATC30	M
URF 5.2	ATC34	M
URF 5.3	ATC41	M
URF 5.4	ATC34, ATC41	M
URF 5.5	ATC31, ATC32	M
URF 5.6	ATC31	M
URF 5.7	Not implemented	C
URF 5.8	ATC6	C
URF 5.9	ATC33	C
URF 5.10	ATC41	C
URF 5.11	Won't have	W

6.1.6   Requirements for viewing data

Requirement ID	Test case	Priority
URF 6.1	ATC35	M
URF 6.2	ATC15	M
URF 6.3	ATC8	M
URF 6.4	ATC11	M
URF 6.5	ATC36	M

Requirement ID	Test case	Priority
URF 6.6	ATC37	M
URF 6.7	ATC38	S
URF 6.8	ATC39	S
URF 6.9	ATC10	S
URF 6.10	ATC12	S
URF 6.11	Not implemented.	C
URF 6.12	ATC62	C
URF 6.13	Not implemented	C
URF 6.14	Not implemented	C
URF 6.15	ATC63	C
URF 6.16	ATC9	C
URF 6.17	ATC40	C
URF 6.18	Won't have	W

6.1.7   Requirements for exporting data

Requirement ID	Test case	Priority
URF 7.1	ATC60	S
URF 7.2	ATC61	S
URF 7.3	Not implemented	C

6.1.8   Requirements for general visualization operations

Requirement ID	Test case	Priority
URF 8.1	ATC18	M
URF 8.2	ATC20, ATC21	M
URF 8.3	ATC20, ATC21	M

6.1.9   Requirements for selection tool

Requirement ID	Test case	Priority
URF 9.1	ATC19	M

Requirement ID	Test case	Priority
URF 9.2	Implemented, but removed based on client feedback.	**M**
URF 9.3	ATC21	**M**
URF 9.4	ATC19	**M**
URF 9.5	ATC19	**M**
URF 9.6	ATC23	**C**
URF 9.7	ATC22	**C**
URF 9.8	ATC24	**C**

6.1.10   Requirements for elemental channels

Requirement ID	Test case	Priority
URF 10.1	ATC25	**M**
URF 10.2	ATC27	**M**
URF 10.3	ATC27	**M**
URF 10.4	ATC26	**M**
URF 10.5	ATC25	**M**
URF 10.6	ATC27	**M**
URF 10.7	ATC29	**M**
URF 10.8	ATC28	**S**
URF 10.9	ATC28	**S**
URF 10.10	ATC28	**C**
URF 10.11	Not implemented	**C**

6.1.11   Requirements for element visualization

Requirement ID	Test case	Priority
URF 11.1	ATC17	**M**
URF 11.2	ATC17	**M**
URF 11.3	Implemented, but removed based on client feedback.	**M**
URF 11.4	ATC20	**S**
URF 11.5	Implemented, but removed based on client feedback.	**S**

Requirement ID	Test case	Priority
URF 11.6	ATC20	S

6.1.12   Requirements for the lens

Requirement ID	Test case	Priority
URF 12.1	ATC46	M
URF 12.2	ATC44	M
URF 12.3	ATC43	M
URF 12.4	ATC42	M
URF 12.5	ATC49	M
URF 12.6	ATC45	S
URF 12.7	ATC47	S
URF 12.8	ATC64	C
URF 12.9	ATC48	C

6.1.13   Requirements for the color segmentation view

Requirement ID	Test case	Priority
URF 13.1	ATC56	M
URF 13.2	ATC57	M
URF 13.3	ATC58	M
URF 13.4	ATC58	M
URF 13.5	Not implemented	S
URF 13.6	Not implemented	C
URF 13.7	ATC59	C
URF 13.8	ATC56	C
URF 13.9	ATC57	C

6.1.14   Requirements for spectral visualization

Requirement ID	Test case	Priority
URF 14.1	ATC15	M

Requirement ID	Test case	Priority
URF 14.2	ATC21	**M**
URF 14.3	ATC16	**S**
URF 14.4	ATC16	**S**
URF 14.5	Not implemented	**S**

6.1.15   Requirements for computing the dimensionality reduction visualization

Requirement ID	Test case	Priority
URF 15.1	ATC13	**M**
URF 15.2	ATC14	**M**
URF 15.3	ATC14	**M**
URF 15.4	ATC14	**M**
URF 15.5	ATC14	**S**
URF 15.6	ATC14	**S**
URF 15.7	ATC14	**S**
URF 15.8	Not implemented	**S**
URF 15.9	Not implemented	**C**
URF 15.10	Not implemented	**C**

6.1.16   Requirements for features of the dimensionality reduction visualization

Requirement ID	Test case	Priority
URF 16.1	ATC51, ATC52	**M**
URF 16.2	ATC51	**M**
URF 16.3	ATC51, ATC52	**M**
URF 16.4	ATC53	**M**
URF 16.5	ATC53	**M**
URF 16.6	Not implemented	**S**
URF 16.7	ATC52	**S**
URF 16.8	ATC54	**S**
URF 16.9	ATC54	**S**
URF 16.10	Not implemented	**C**
URF 16.11	Not implemented	**C**

Requirement ID	Test case	Priority
URF 16.12	ATC55	**C**

6.1.17   Requirements for context visualization

Requirement ID	Test case	Priority
URF 17.1	Not implemented	**S**
URF 17.2	Not implemented	**S**
URF 17.3	Not implemented	**S**

6.1.18   Requirements for application theming

Requirement ID	Test case	Priority
URF 18.1	ATC65	**C**
URF 18.2	ATC66	**C**

6.1.19   Requirements for the documentation

Requirement ID	Test case	Priority
URF 19.1	Tested outside of ATP	**M**
URF 19.2	Tested outside of ATP	**M**
URF 19.3	Tested outside of ATP	**M**
URF 19.4	Tested outside of ATP	**M**
URF 19.5	Tested outside of ATP	**M**
URF 19.6	Tested outside of ATP	**M**
URF 19.7	Tested outside of ATP	**M**
URF 19.8	Tested outside of ATP	**C**

6.2 CONSTRAINT REQUIREMENTS

6.2.1 Requirements for licensing

Requirement ID	Test case	Priority
URC 1.1	Tested outside of ATP	**M**
URC 1.2	Tested outside of ATP	**C**
URC 1.3	Tested outside of ATP	**C**

6.2.2 Requirements for usability and version

Requirement ID	Test case	Priority
URC 2.1	Precondition for the test procedure	**M**
URC 2.2	Precondition for the test procedure	**M**
URC 2.3	ATC68	**M**
URC 2.4	All test cases	**M**
URC 2.5	Precondition for the test procedure	**M**
URC 2.6	Possibly implemented, not tested	**S**
URC 2.7	Possibly implemented, not tested	**S**
URC 2.8	Possibly implemented, not tested	**C**
URC 2.9	Possibly implemented, not tested	**C**

6.2.3 Requirements for performance and reliability

Requirement ID	Test case	Priority
URC 3.1	ATC32	**S**
URC 3.2	ATC31	**S**
URC 3.3	All test cases including opening views	**S**
URC 3.4	ATC20, ATC21	**S**

A   SIGNING PAGE

Hereby the client, the supervisor and the development team agree upon this document.

Client

Name

_____

Date

_____

Signature

_____

Supervisor

Name

_____

Date

_____

Signature

_____