

Euro BioImaging Preparatory Phase II Project

**D6.4 Design of UX and UI for IRP,
presented to all participants for feedback as mock-ups**

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Abstract

Imaging is a ubiquitous tool and is used in a significant portion of biological and biomedical studies. A critical part of any imaging study is the analysis and processing of the data. These steps are critical to maximise the quality of data and convert raw pixel data into results. There are a diverse set of image processing and analysis tools that are appropriate for use in different situations and that provide a wide range of different types of results. In this Deliverable, we describe the design of the UI for the Image Tool Resource (ITR), an on-line catalogue of software tools for bioimage processing and analysis. The ITR design includes lists of tools, sample datasets, and wherever possible reuses annotations and ontologies from other projects. The IT design provides a starting point for developing the fully functional, production ITR.

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1. Introduction

Imaging is a ubiquitous tool and is used in a significant portion of biological and biomedical studies. In almost all experimental regimes and protocols, imaging data recorded as an analog signal is converted to digital values and automatically stored in a digital storage system and then processed by software tools that convert the spatiotemporal measurements recorded by the imaging system(s) into analytic results. The software tools that produce these results therefore are key components of any digital imaging workflow.

Several community surveys, including those run by Euro-BioImaging, German BioImaging, BioImagingUK, France BioImaging, and NEUBIAS have repeatedly confirmed the importance of these tools. Tool users repeatedly and consistently indicate they require tools that are easily accessed, installed and run. In addition, there have been repeated requests for the establishment of a central “portal” or “resource” that provides a single, known access point for both open source and commercial versions of these tools. Survey respondents repeatedly state that the resource should use standardised annotations to define and characterise the functions and requirements of these tools and also provide example datasets and workflows for all of them.

This deliverable describes our progress towards these goals, defines specific user targets and explains the linkage and collaboration between Euro-BioImaging and other projects that are working towards related goals. Finally we present the current state of the UIs for tool annotation and workflows.

2. Previous Work Defining Requirements and Scope

The high level requirements for the tools resource were defined during Euro-BioImaging Preparatory Phase I (PPI) in D11.5 and D11.6 (<http://www.eurobioimaging.eu/content-page/documents-gallery>). These deliverables emphasised the need for including tools from commercial and open source suppliers and projects respectively, and the need to support open file formats. Wherever possible, imaging tools should adopt or conform to community standards that are emerging (and that Euro-BioImaging will increasingly drive) regarding, for example, input and output formats and interoperability. A public, online portal for these tools should include annotations that describe intended use, requirements, ease of use and adherence to community standards.

3. Target User Communities

When considering how to build the resource(s) that deliver on these requests, it is important to consider the types of users it is (they are) meant to serve. Examination of the types of users who responded to the Euro-BioImaging community survey in 2012 (D11.4 in Euro-BioImaging PPI (<http://www.eurobioimaging.eu/content-page/documents-gallery>)) revealed a wide range of experimental scientists, image analysts, and computational scientists, all of

whom should be served by the proposed resource. Delivering useful, usable tools for this diverse European imaging community is a substantial but critical challenge for the developers of Euro-BioImaging's data services and resources.

4. Collaborative Efforts with Partner EU Projects and Communities

Euro-BioImaging PPII WP6 initiated work on building the ITR tool resources, at the initiation of the project in the beginning of 2016. At almost the same time, Global Bioimaging (H2020 Grant Agreement N. 653493) and the NEUBIAS (COST: CA15124) initiated work with related goals to build open, community-facing imaging tool resources. The presence of these non-overlapping, but complementary projects highlights the importance and demand for imaging tool resources across the European and international imaging community. It also presents an opportunity to leverage different projects ideas, work and expertise to achieve as many of the ambitious goals for a community tool resource as possible. In this spirit, Euro-BioImaging PPII WP6 has engaged with Global BioImaging WP4 and NEUBIAS WG4 (the projects share several common participants). Our overall goal is to define points of synergy and collaboration across these three projects and ensure that our efforts, as much as possible, combine and intersect to produce a coherent, useful set of resources for the imaging community.

5. Naming the Resource— from “IRP” to “ITR”

In our original WP6 workplan, we used the term “Imaging Resource Portal” to refer to the repository of annotated, validated imaging tools. As WP6 has progressed, in particular in its survey of existing image data resources in D6.1, its development of a public on-line Image Data Resource (IDR; <http://idr.openmicroscopy.org/> and D6.5), and the development of the Euro-BioImaging Web Access Portal in WP5, we found that the original name for the “Imaging Resource Portal” didn't distinguish it sufficiently from these other public, on-line tools. Therefore we have renamed this resource as the “Imaging Tools Resource” (ITR). The new name describes the function and content of a portal for imaging tools more accurately and will ensure there is no confusion about the services it provides.

6. Specifying Target Users and Design Considerations for an Imaging Tools Resource

As noted above, the ITR must be a resource for a broad, diverse European imaging community. It must enable Experimental Scientists to find tools they can use to process and analyse the images they collect in their experiments. It must serve Computational Scientists, Bioimage Analysts and Algorithm Developers, allowing all these constituencies to find and share imaging tools.

WP6's approach to this diverse imaging community is detailed in D6.5. We have adopted the same approach in this Deliverable, and in our strategy for the user interface (UI) and user

experience and workflow (UX) for the ITR. Briefly, we recognise that modern scientists work on a continuum ranging from Experimentalists, Image Analysts to Computational Biologists and have chosen to support these constituencies. Therefore, mindful of this, we will capture the needs of a substantial overlap group of users that cover these extremes. In general, we expect Experimentalists to use the ITR to identify tools and what they do, and Image Analysts and Computational Scientists to use the ITR as a reference site for workflows, analysis strategies and example datasets.

7. Controlled Vocabularies for Imaging Tools

In D6.3 we provided a survey of existing "tags" for imaging analysis and processing tools, largely based on community "taggathons" run during Euro-BioImaging PPI. While comprehensive and descriptive, this collection contained all of the limitations of tag-based annotations - sporadic coverage of topics, misspellings, overlapping or redundant terms etc. Nonetheless, the value of systematic annotation of imaging tools in a web-based UI was clear. In response NEUBIAS has initiated the development of a controlled vocabulary for imaging analysis and processing tools. Following best practice principles, NEUBIAS has re-used existing resources and extended an established ontology EDAM (<https://bioportal.bioontology.org/ontologies/EDAM-BIOIMAGING>) to include coverage of different techniques and approaches in image processing and analysis. Euro-BioImaging WP6 has followed this work and it appears to be accurate and productive. For these reasons, Euro-BioImaging WP6 aims to use the EDAM BioImaging controlled vocabulary developed by NEUBIAS for annotating image processing functions in the ITR. When implemented in a web-based UI, lists of on-line tools and annotations will be valuable resources for the Experimentalist user.

8. ITR UX/UI Plan

Delivering all of these functions across the range of user profiles is a significant task. WP6 aims to deliver the smallest number of access points possible, while ensuring an appropriate UX for all European imaging scientists. Moreover, WP6 aims to connect with and where appropriate, re-use resources developed by WP4 of GBI and WG4 and WG5 of NEUBIAS. Figure 1 shows a proposed plan that WP6 is building with GBI and NEUBIAS to define what systems are being and will be built and how they will be linked.

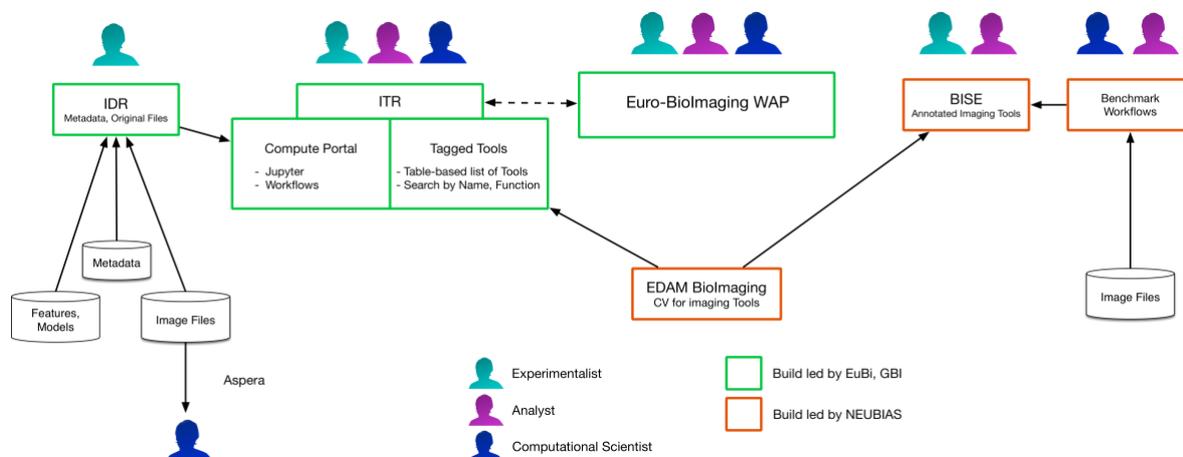


Figure 1. ITR UI Plan for Experimental and Computational Users

8.1 Experimentalists: Tool Identification and Search

Experimentalists require a simple UI that implements browsing of tool lists and search for specific items. As NEUBIAS develops its EDAM-based annotation list, WP6 will implement a table-based UI that support sorting based on name and type of tool and EDAM terms. We aim to make each row of the table a different tool, with columns for various metadata about each tool. Selecting any tool (i.e., clicking on its name) will move to a dedicated auto-generated page that lists each tool and its associated metadata.

8.2 Computational Scientists: Workflows and Linkages to IDR Data

To ensure support for the diverse range of use cases for the ITR, WP6 aims to provide not only a web-based list of tools with annotations, but on-line resources that include test datasets and cloud-based template workflows that combine each tool, appropriate datasets and analytic results. These should be resources that Computational Scientists can reference and where appropriate re-use. For access to computational workflows, ITR will use a Jupyter resource that allow Python- and Java-based workflows, including ImageJ plug-ins, to be executed from a web browser. In this way, tools annotated in the ITR Web UI can be tested and run in live datasets. The current proof of concept implementation of this is available at <http://idr.openmicroscopy.org/jupyter> (an established GitHub account is required for access to this resource. See the Supplemental Note to the published paper on IDR at <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5536224/#SD1> for more details). Notebooks for examining calculated features, downloading image planes for IDR, and listing features are currently available.

9. ITR UX/UI Mock-Up

Figure 2 shows the proposed layout for the first version of the ITR, as approved by the PPII project participants. In this first version, ITR will be deployed alongside the current IDR, so we have included the IDR CSS to maintain the look and feel. Links to annotated tools on NEUBIAS' BISE resource (<http://www.biii.eu/>), EDAM ontology terms and example datasets in IDR are included. All columns are sortable, and can be used to re-order the presentation of the tools. In D6.2, we proposed to use bio.tools (<https://bio.tools/>) as a backend database and data model for the ITR. However the data model changes required by WP6 and NEUBIAS could not be added in time for this deliverable, so we have chosen the EDAM ontology as a basis for annotation of ITR tools. As EDAM and ITR develop, they function as a structured reference for the bio.tools project, which will allow future adaptation and integration with the bio.tools data model.

The ITR pages are currently cast in HTML, making manual updates and maintenance straightforward. In the future Euro-BioImaging's IT and NEUBIAS' BISE resource can consider using a common tool resource (for example, BioTools customised for tools used by the imaging community) to improve maintainability and consistency.



BISE Tool ▲▼	Project ▲▼	Domains	Tags	Datasets
CellProfiler	http://cellprofiler.org/	Screening Bio-Imaging Medical Imaging	Feature extraction , Image classification , Automated , Manual	idr0016 (22 GB) idr0033 (30 GB) idr0036 (20 GB)
Icy	http://icy.bioimageanalysis.org	Bio-Imaging Medical Imaging	Stand-alone application , Manual , Platform (Processing)	
ilastik	http://www.ilastik.org	Bio-Imaging Medical Imaging	Feature extraction , Image classification , Automated , Manual	
ImageJ / Fiji	http://imagej.net/ http://fiji.sc/	Bio-Imaging Medical Imaging	Stand-alone application , Manual , Platform (Processing)	idr0045 (200 ROIs)
Knime	https://www.knime.com/	Bio-Imaging Medical Imaging	Automated , Manual Platform (Workflow)	

Figure 2. Mock-up of sample IT page.

10. Conclusions

The proposed ITR is a critical tool that has been highlighted in several community surveys and in several European imaging projects. WP6, in consultation with GBI and NEUBIAS has produced a first mock-up of the ITR and this has been approved by the Euro-BioImaging Preparatory Phase II project partners. Work is initiated to build and populate this resource, and make it a truly useful tool for the wider Euro-BioImaging community.