Databrowse: An extensible data management platform

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Databrowse: An Exensible Data Management Platform
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1 Introduction

Databrowse is an extensible web-based platform for data viewing, manipulation, and management. At the most basic level, Databrowse is a file browser; however, simple plugins enable Databrowse to represent data of a variety of formats in a consistent way, enabling rapid viewing and transformation of those views to narrow in on features of interest. The plugin architecture enables Databrowse to be adapted to support any data format in which knowledge of the data format is available. Data from multiple sources or formats can be pulled together into combined representations and then further transformed as desired. Furthermore, all of these transformations are performed in real time.

1.1 Motivation

Databrowse was originally developed to aid in viewing and analyzing data collected in the field of nondestructive evaluation (NDE). NDE is a broad, highly interdisciplinary field related to the development of measurement techniques that find and characterize material flaws and condition. Some well known NDE techniques include visual/liquid penetrant inspection, magnetic particle inspection, ultrasonics, radiography, and eddy current testing.

NDE techniques are capable of generating considerable amounts of data in very short periods of time. However, many industrial NDE inspections today produce a simple pass/fail response as a result of a testing process. Recorded raw data is often viewed as useless, or potentially even a liability, unless we have ways to extract useful information. Ultimately, the problem of finding a needle in a haystack is particularly challenging, especially if you do not know what you are looking for.

Even in research scenarios where we desire to collect large quantities of data to examine specific items, handling large quantities of data can still be a challenge. As a part of a recent modeling effort related to development of a forward model for vibrothermography, a nondestructive testing technique that utilizes vibration-induced heating to located cracks in materials, the need became apparent for better tools and data management practices. It was known at the beginning of the work that a considerable amount of data was to be generated. In the end, a final data table containing almost 25,000 entries was generated, along with over 0.5 TB of raw data.

The authors sought to develop a tool that would help in the short term for dealing with the latter problem, while serving as a spring board to further work toward dealing with the former problem. Databrowse was the resulting tool.

1.2 Implementation

1.2.1 XML

Databrowse represents data as XML. XML (eXtensible Markup Language) is a standard that allows text data to be hierarchically structured utilizing arbitrarily defined tags. Special engines can then be used to parse and manipulate such structured data. Figure 1 shows an example of a simple data set being structured and stored in an XML format. The first line of the sample XML file shows an experiment tag, and the last line shows that tag being closed. Everything contained between the opening and closing tags can be described as children. In this context, our measurements are children of the experiment. Thus, a hierarchical data structure can be developed. Subsequently, we have represented all of the individual parameters for each measurement as children of that measurement.

We can take it a step further and indicate that one of these parameters could have multiple values, as seen with the voltage data. This is one major advantage of this type of data structure, as our spreadsheet style data table does not necessarily make representing this type of data structure easy. We have made it work here with a comma list of values in our data table; however, this does not work so easily with more complicated data.

Furthermore, XML tends to work very nicely as a way of representing most data, since many frequently used data formats internally represent data in a natural hierarchical structure, often as a convenient way of dealing with the issue just described. Therefore, conversion to XML, if even required, is generally very straightforward. Once represented as XML, Databrowse is able to leverage the power and speed of the open

#	Sample	Voltage	Result
1	A-001	1V, 2V, 3V	10
2	A-002	1.5V	15
3	B-004	1.5V, 3V	12

Simple Experimental Data Table

Converted and Stored in a Simple XML Representation

```
<experiment>
  <measurement>
    <measnum>1</measnum>
    <sample>A-001</sample>
    <voltages>
      <voltage units="V">1</voltage>
      <voltage units="V">2</voltage>
      <voltage units="V">3</voltage>
    </voltages>
    <result>10</result>
  </measurement>
  <measurement>
    <measnum>2</measnum>
    <sample>A-002</sample>
    <voltages>
      <voltage units="V">1.5</voltage>
    </voltages>
  </measurement>
  <measurement>
    <measnum>3</measnum>
    <sample>B-004></sample>
    <voltages>
      <voltage units="V">1.5</voltage>
      <voltage units="V">3</voltage>
    </voltages>
  </measurement>
</experiment>
```

Opening Tag
Parent
Children
Tag Name
Attribute
Attribute Name
Attribute Value
Closing Tag

Figure 1: Sample XML Data

source XML engine libxml2. The result is being able to parse and transform considerable amounts of data in seconds.

It is important to note that raw binary waveforms are not intended to be represented as XML; however, pieces of them might be. More typically though, a plugin would utilize an interface provided by Databrowse that enables the creation of images of such data. Such an image can be generated in real time and served to the web browser by Databrowse. This would not be limited to images. Any format that could be displayed in a web browser could be used, such as videos, animations, or any format that can use a web browser plugin to display.

1.2.2 XSLT

Databrowse utilizes XSLT to transform data. XSLT (eXtensible Stylesheet Language Template) provides an interface by which the user can define a set of transformations to be applied to XML data. In other words, XML data and XSLT templates designed to act on that data are provided to the XSLT engine and the engine will output a new set of XML data based on the transformation provided. This behavior can be seen in Figure 2, where our sample data from Figure 1 has been transformed using an XSLT template.

Databrowse, being a web based platform, wants to build web pages utilizing the data being provided. HTML, the language with which web pages are built, is a type of XML. As a result, our XSLT transform is able to take our data file and build a web page dynamically in real time. Databrowse then handles the process of serving that web page to a user in their web browser.

1.3 Databrowse Plugins

Databrowse plugins are responsible for providing the following: 1) registering the file types with which they should be able to operate on, 2) providing an XML representation of the file, and 3) providing an XSLT transform that converts the XML representation to the desired HTML view that is displayed in the web browser. Plugins are also able to provide additional features that can be triggered or accessed from the web view. Such features might include the automatic generation of animations, data conversions, or running of processing scripts.

Since every file can be represented as XML, Databrowse provides an interface for recursively obtaining an XML representation of entire directories and sub-directories. Thus, a single representation of multiple files can be obtained. In addition to providing a set of plugins for some common file types, Databrowse

XML File

```
<experiment>
  <measurement>
    <measnum>1</measnum>
    <sample>A-001</sample>
    <voltages>
      <voltage units="V">1</voltage>
      <voltage units="V">2</voltage>
      <voltage units="V">3</voltage>
    </voltages>
    <result>10</result>
  </measurement>
  <measurement>
    <measnum>2</measnum>
    <sample>A-002</sample>
    <voltages>
      <voltage units="V">1.5</voltage>
    </voltages>
    <result>15</result>
  </measurement>
  <measurement>
    <measnum>3</measnum>
    <sample>B-004</sample>
    <voltages>
      <voltage units="V">1.5</voltage>
      <voltage units="V">3</voltage>
    </voltages>
    <result>12</result>
  </measurement>
</experiment>
```

+

XSL Stylesheet

```
<xsl:stylesheet xmlns="http://www.w3.org/1999/xhtml"
  xmlns:xsl="http://www.w3.org/1999/XSL/Transform">
  <xsl:template match="experiment">
    <html>
      <head/>
      <body>
        <table>
          <tr>
            <th>#</th><th>Sample</th><th>Result</th>
          </tr>
          <xsl:apply-templates />
        </table>
      </body>
    </html>
  </xsl:template>
  <xsl:template match="measurement">
    <tr>
      <td><xsl:value-of select="measnum" /></td>
      <td><xsl:value-of select="sample" /></td>
      <td><xsl:value-of select="result" /></td>
    </tr>
  </xsl:template>
</xsl:stylesheet>
```

↓

HTML Representation

HTML Source Code

```
<html>
  <head/>
  <body>
    <table>
      <tr><th>#</th><th>Sample</th><th>Result</th></tr>
      <tr><td>1</td><td>A-001</td><td>10</td></tr>
      <tr><td>2</td><td>A-002</td><td>15</td></tr>
      <tr><td>3</td><td>B-004</td><td>12</td></tr>
    </table>
  </body>
</html>
```

Web Browser View

file:///tmp/test.html

file:///tmp/test.html

#	Sample	Result
1	A-001	10
2	A-002	15
3	B-004	12

Figure 2: Sample XML Data being Transformed with XSLT

includes some plugins designed to provide a simple interface for building such combined representations. XSLT transformation stylesheets can also be provided on a per-directory basis if additional control is needed for specific use cases.

2 Installing Databrowse

2.1 Software Requirements and Dependencies

Databrowse requires the use of a WSGI compliant web server. Databrowse has been tested extensively with mod_wsgi on Apache 2.2.15 on Red Hat Enterprise Linux 6.6 and Apache 2.4.10 on Ubuntu 15.04. The usage of mod_wsgi, Apache, and a Unix-based operating system are strongly recommended. Using Apache on Windows has been preliminarily tested; however, its use is strongly discouraged at this time due to file path issues that will be resolved in a later version of Databrowse.

Modern versions of Mozilla Firefox and Google Chrome are recommended for accessing Databrowse. Usage of Microsoft Internet Explorer is strongly discouraged. Microsoft Edge has not yet been tested.

Databrowse is dependent upon Python 2 (2.6 or later, Python 3 is not supported at this time). Databrowse also requires the following Python modules (available from PIP or the package management systems on Red Hat and Ubuntu):

- python-lxml version 3.2 or greater
- python-magic version 0.2 or greater
- python-numpy version 1.8 or greater
- python-pillow version 2.3 or greater

Several Databrowse plugins packaged with the distribution also require the use of the following Python modules:

- python-qrcode version 4.0 or greater
- Dataguzzler Python Bindings (`http://thermal.cnde.iastate.edu/dataguzzler`)
- Dataguzzler Units Support (`http://thermal.cnde.iastate.edu/dataguzzler`)

Databrowse also requires the use of mod_rewrite for URL rewriting. Databrowse can be ran without this support enabled; however, its use has not been tested extensively.

2.1.1 Experimental Windows Use

A set of binary packages providing the necessary prerequisites have been compiled and are available upon request for usage with Apache on Windows. These packages require the usage of Apache compiled against the Microsoft Visual C++ 9 Runtime. This is a limitation imposed by Python 2. WampServer 2.2d is one such binary distribution of Apache that meets these requirements. Please contact the author for additional information.

2.2 Installation on Unix-based Platforms

The necessary minimum prerequisites can be installed using the following commands on Debian-based platforms:

```
sudo apt-get install python2.7 python-lxml python-magic python-numpy python-pip libjpeg \
   libjpeg-dev libfreetype6 libfreetype6-dev zlib1g-dev apache2 libapache2-mod-wsgi     \
   libapache2-mod-rewrite python-dev python-setuptools libtiff5-dev libjpeg8-dev        \
   zlib1g-dev liblcms2-dev libwebp-dev tcl8.5-dev tk8.5-dev python-tk
sudo pip install pillow
```

And for Fedora-based platforms:

```
sudo yum install python python-lxml python-magic python2-numpy python-pip libjpeg-turbo \
   libjpeg-turbo-devel freetype freetype-devel zlib zlib-devel httpd mod_wsgi           \
   python-devel redhat-rpm-config libtiff-devel libjpeg-devel zlib-devel freetype-devel \
   lcms2-devel libwebp-devel tcl-devel tk-devel
sudo pip install pillow
```

The package `redhat-rpm-config` is only required on Fedora 23 or later. The command `dnf` may also be exchanged for `yum` on newer Fedora-based platforms as well. Obtain the Databrowse source from the Databrowse website or from the GitHub repository (coming soon). From within the root directory, run the following command:

```
sudo python setup.py install
```

This will install the Databrowse library components into the the Python site-packages directory. Ensure that the necessary Apache modules are running and available by running the following command for Debian platforms:

```
sudo a2enmod wsgi
sudo a2enmod rewrite
```

And for Fedora platforms, both modules should be enabled by default. Verify the presence of the following lines in the file `/etc/httpd/conf/httpd.conf` or in any files contained in `/etc/httpd/conf.d/` or `/etc/httpd/conf.modules.d`:

```
LoadModule rewrite_module modules/mod_rewrite.so
LoadModule wsgi_module modules/mod_wsgi.so
```

From the Databrowse source folder, copy the contents of the databrowse_wsgi folder to an appropriate location. For example, to install the server components in `/var/www/databrowse`, use the following command from within the Databrowse source folder:

```
sudo mkdir /var/www/databrowse
sudo cp -a databrowse_wsgi/* /var/www/databrowse/
sudo chmod -R 755 /var/www/databrowse
```

Apache must now be configured. If working on a Debian-based system with a newer version of Apache, create the file `/etc/apache2/sites-available/databrowse.conf` with the following example contents and adjust as necessary for your system. On Fedora-based systems, the file name should be `/etc/httpd/conf.d/databrowse.conf` with the contents below adjusted as necessary:

```
WSGIScriptAlias /databrowse /var/www/databrowse/databrowse.wsgi
Alias /dbres /var/www/databrowse/resources

<Location "/databrowse">
    # Implementation of proper user controls is strongly encouraged!

    # Require SSL is also Strongly Encouraged But Must Be Appropriately Configured
    # Also be sure to modify databrowse_wsgi.conf to reflect ``https''
    # instead of ``http'' on all URLs

    # SSLRequireSSL

    Options FollowSymLinks

    # Rewrite Rules - No Modification Should Be Needed Unless You Change Location Above
    RewriteEngine on
```

```
    RedirectMatch ^databrowse$ /databrowse/
    RewriteCond %{QUERY_STRING} path=
    RewriteRule ^(.*)/databrowse\.wsgi(.*)$ $1/databrowse.wsgi [QSA]
    RedirectMatch ^databrowse$ /databrowse/
    RewriteCond %{QUERY_STRING} !path=
    RewriteRule ^(.*)/databrowse\.wsgi(.*)$ $1/databrowse.wsgi?path=/$2 [QSA,L]
</Location>
```

WARNING! Improper configuration of a web server can leave your computer and data at risk of exposure. Databrowse does not provide any built-in authentication mechanism nor should it be relied on to prevent access to files outside of the configured data root. Accordingly, usage of Databrowse on computer systems in which web server access is available from the Internet is strongly discouraged without the usage of SSL and an appropriate Apache authorization module. It is strongly encouraged that anyone deploying Databrowse for use over the Internet be comfortable with securely configuring and using Apache. The authors provide no warranty and are not responsible for loss or damages. Please see the Databrowse license for additional information.

The above configuration assumes that the Databrowse WSGI components are installed in `/var/www/databrowse` and will serve Databrowse from `http://localhost/databrowse` and will serve Databrowse static resources from `http://localhost/dbres` on a default installation of Apache on Debian-based systems. The above configuration will utilize server default access permissions, so, you may wish to add additional configuration or ensure that your web server is not accessible from the Internet. Refer to the warning above.

The following command is required for Debian-based systems only and can be used to enable Databrowse:

```
sudo a2ensite databrowse.conf
```

Prior to restarting Apache, the files `databrowse_wsgi.conf` and `databrowse_style.xml` (or symbolic links to these files) must exist in the same directory as `databrowse.wsgi`. It should be sufficient to simply rename the file `databrowse_style.sample.xml` to `databrowse_style.xml` until you are ready to customize the appearance of Databrowse. The `databrowse_wsgi.conf` file will require some additional configuration. A sample file `databrowse_wsgi.sample.conf` is provided.

The most critical line that must be changed in `databrowse_wsgi.conf` from the sample provided file is `self.dataroot`. This should be set to the absolute path of the directory containing the data you wish Databrowse to serve. Databrowse provides very simple checks to keep the user inside directories below this path; however, this should not be used as a method of security! Symbolic links pointing out of this directory will be followed and there may be other methods available for a user to escape out of the data root path.

Additionally, you may wish to set `self.requireuser=False` if you do not presently have authenticaion configured on Apache. This may be okay if your Apache instance is only accessible from the local machine. However, if it is accessible to the world, it is highly encouraged to correctly configure authentication. See the previous warning about security.

If you have SSL properly configured on your web server and you uncommented the `SSLRequireSSL` line in `databrowse.conf`, you should update all URLs in `databrowse_wsgi.conf` to show `https` at the beginning instead of `http`.

It is also worth noting that files contained within data root must be at least readable by the web server process owner. To take advantage of the full capabilities of Databrowse, you will also want write access available to the web server process owner as well. Again, use caution when using Databrowse, especially if you are not familiar with securely configuring Apache. Additionally, if using SELinux or similar systems, you will need to make additional configuration changes to ensure the web server process has read/write access to all files in the data repository. On newer Fedora systems, for example, if you set your `dataroot` to `/home/databrowse`, then you could run the following command to allow access to Apache:

```
sudo chcon -R -t httpd_sys_rw_content_t /home/databrowse
```

Within `databrowse_wsgi.conf`, you will also want to ensure that `self.siteurl` and `self.resurl` are correct if you have changed any Apache settings from the defaults. You should also ensure that the directory listed in `self.checklistpath` has been created within the data root directory. This setting is related to

the Checklist plugin, but, Databrowse presently will not run if this directory does not exist. This will be corrected in future versions of Databrowse.

Please see Chapter 4 for more information on these files.

Restart the web server and Databrowse should now be ready for use. On Debian-based systems:

```
sudo service apache2 restart
```

On Fedora-based systems:

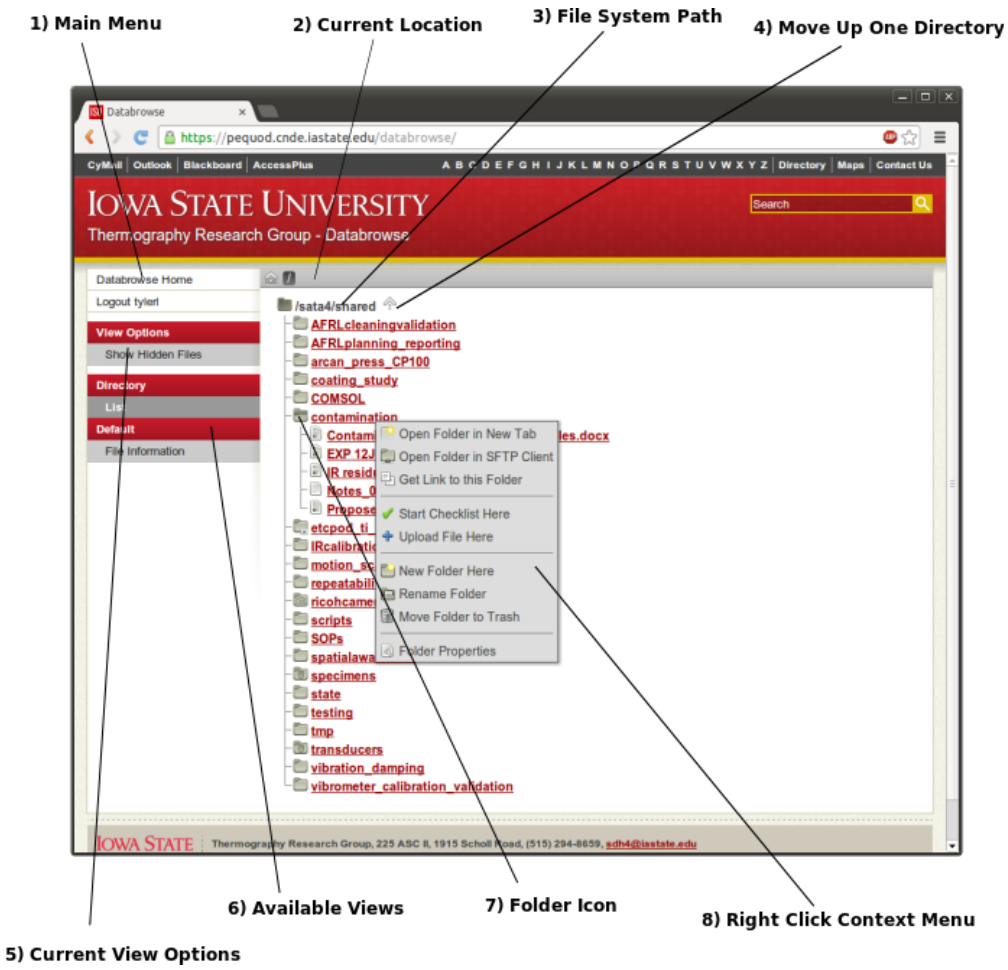
```
sudo service httpd restart
```

You should now be able to access Databrowse by visiting `http://localhost/databrowse` in your web browser.

3 Getting Started

This section will provide some information on using the directory interface within Databrowse.

3.1 Features of Interest



1. **Main Menu**
   Contains links to jump to the data directory root, logout, and switch views

2. **Current Location**
   Displays the location of the current view relative to the data directory root – click a folder name to jump to it

3. **File System Path**
   Displays the absolute path of the current view in the file system

4. **Move Up One Directory**
   Click this link to move up one directory until you reach the data directory root

5. **Current View Options**
   Displays a list of options available to modify the current view

6. **Available Views**
   Displays a list of various plugins that are capable of rendering the current file or folder and views available within those plugins

7. **Folder Icon**
   Click this folder icon to expand the folder and dynamically load the contents of the sub folder

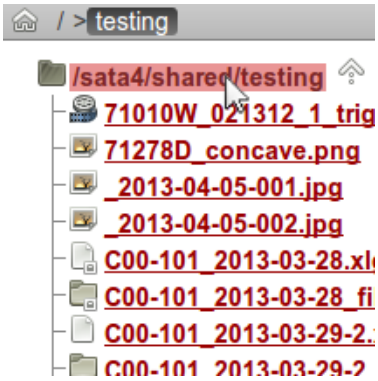
8. **Right Click Context Menu**
   Right click the name of any folder or file in this view to display this context menu

3.2 Creating New Directories

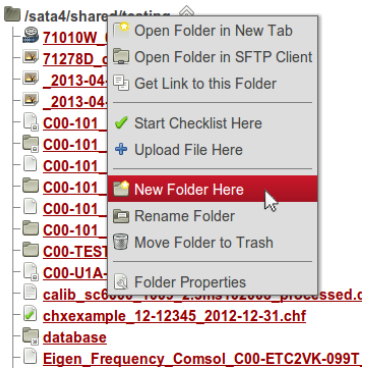
The following steps can be used to create new directories from Databrowse:

1) Navigate to the Folder that will Contain the New Folder
Using the Databrowse interface, locate the folder that will contain the folder you wish to create.

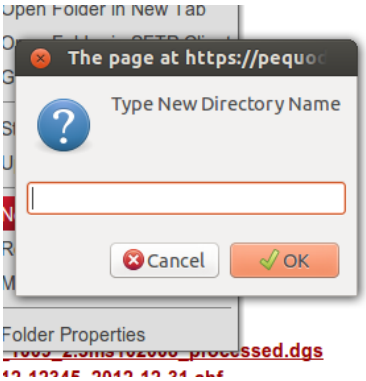
2) Right Click Folder Name to Open Context Menu
Using the mouse, right click on the name of the folder you wish to contain your new folder. If the current view is the location you wish to create a new folder within, right click on the black text at the top. This is the shaded area shown on the figure to the right.



3) Select New Folder Here from the Context Menu



4) Type a Name and Click OK
Type a name for your new folder. Spaces are special characters that are permitted in folder names on your operating system may be used; however, their use is discouraged.



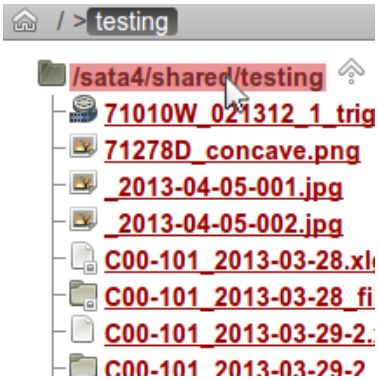
5) Finished!
You will be taken to the new folder automatically.

3.3 Uploading Files

The following steps can be used to upload files using Databrowse:

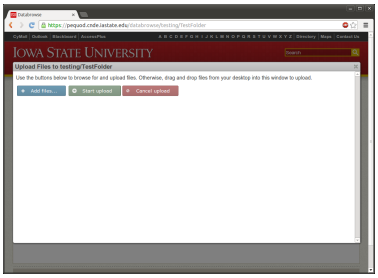
1) Navigate to the Folder in which you wish to Upload Files
Using the Databrowse interface, locate the folder that will contain the files you wish to upload.

2) Right Click Folder Name to Open Context Menu
Using the mouse, right click on the name of the folder in which you wish to upload files. If the current view is the location you wish to upload files to, right click on the black text at the top. This is the shaded area shown on the figure to the right.



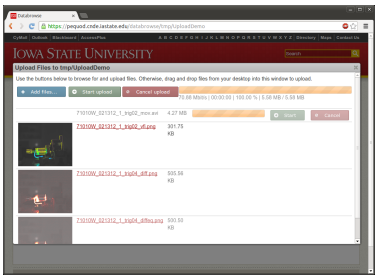
3) Select Upload Files Here from the Context Menu

4) Click Add Files to Open the File Selection Box
Inside the file selection box, you may hold Shift or Ctrl on the keyboard to select multiple files. Select Open once you have chosen the file(s) you wish to upload. Repeat for any additional files to be uploaded. The options you have selected will appear in the window.



Alternatively, Drag and Drop Files into the Upload Window
Using Windows Explorer, Finder, or Nautilus, depending on your operating system, you may drag files into the open space on the upload window. The files will appear in the window.

5) Click Start Upload
You should see progress bars indicating the length of time remaining to upload your files. If uploading photos, you will see a preview thumbnail of the photo.



6) Click the X or Click Outside of the Upload Window to Close
The page will automatically refresh to show your new files. Do not close the window while uploading is still taking place or your upload will be interrupted.

4 Databrowse Configuration Options

This section provides information about the various configuration options that can be used to customize the low level functionality of Databrowse.

4.1 databrowse_wsgi.conf

The file `databrowse_wsgi.conf` (or a symbolic link to this file) must be contained inside the same folder as `databrowse.wsgi`. This file is a Python script that can be used to run code during the start of a web request to the server. It is ran within the context of the `web_support.py` file contained within `databrowse/support` in the source distribution. `web_support.py` is actually a Python class which is instantiated with the configuration from `databrowse_wsgi.conf` and the default values contained within the class at the start of a request. This code is ran directly during the call to `web_support.__init__`. Accordingly any Python code can be included within `databrowse_wsgi.conf` and it will be executed in this context.

The following options can be set in this file:

Site URL `self.siteurl` (*String*)
Default: `http://localhost/databrowse`
The full URL to Databrowse. This is used internally to build URLs. No trailing slash should be used if search engine optimized URLs are enabled. If you disable search engine optimized URLs, you should update this to list the full URL to `databrowse.wsgi`.

Resource URL `self.resurl` (*String*)
Default: `http://localhost/dbres`
The full URL to Databrowse static resource files. This is used internally to build URLs to static JavaScript, images, stylesheets, etc.

Logout URL `self.logouturl` (*String*)
Default: `http://localhost/logout`
The URL to use in order to trigger the web server's logout mechanism. This will need to be adjusted depending on your authentication method.

Icon Configuration File `self.icondbpath` (*String*)
Default: `os.path.join(os.path.dirname(databrowse.support.__file__), "iconmap.conf")`
The path to a file containing a ConfigParser-compatible configuration file associating file extensions with icons. See 4.2 for more information about the contents of this file.

Hidden File Configuration File `self.hiddenfiledbpath` (*String*)
Default: `os.path.join(os.path.dirname(databrowse.support.__file__), "hiddenfiles.conf")`
The path to a file containing a ConfigParser-compatible configuration file containing Glob syntax strings that can be used to hide certain files from view in the Databrowse directory views. See 4.3 for more information about the contents of this file.

Search Engine Optimization `self.seo_urls` (*Boolean*)
Default: `True`
When set to true, Databrowse will write out URLs that have been search engine optimized. Instead of the URL `http://localhost/databrowse.wsgi?path=/SOPs`, the URL would be written as `http://localhost/databrowse/SOPs`. Usage of this feature requires `mod_rewrite` to be enabled with the options as suggested in the Installation instructions. It is strongly encouraged to keep this feature turned on.

Other options can also be set in this file using the same format, if desired, for use in Databrowse plugins.

4.2 iconmap.conf

This file generally does not need to be modified, unless you wish to build or modify plugins. This file tracks the mapping between file types and icons. These icons are used to provide a graphical representation of a file type within Databrowse. The file uses a Python ConfigParser module compatible format. There are two sections that can be used inside this file: `[Content-Type]` and `[Extension]`. Content types are defined as specified in RFC 2045 and are determined utilizing libmagic. File extensions are matched against the potion of the filename after the final period. The content-type or extension becomes the parameter name in `iconmap.conf` and the parameter value is the name of the file containing the icon served at the URL `icons/` relative to the Databrowse resources URL (e.g. `http://localhost/dbres/icons/folder.png`).

The following is an example of how this file is laid out:

```
[Content-Type]
inode/directory=folder.png
application/x-directory=folder.png

[Extension]
txt=text-x-generic.png
html=text-html.png
```

All files that are unable to be matched with a configuration option are given the icon `unknown.png`.

4.3 hiddenfiles.conf

This file can be used to hide files based on their file name. Glob expressions are permitted. This file uses a Python ConfigParser module compatible format. There are two sections that can be used inside this file: `[Hidden]` and `[Shown]`. The hidden section is used to define file names or glob expressions for filenames that should be hidden from the Databrowse directory view. The shown section can be used to override glob expressions contained in the hidden section for explicit file names. Glob expressions are also permitted here. The parameter name is used only for comment and will be ignored by Databrowse. The parameter value will be used by Databrowse to filter file lists in the directory view.

The following is an example of how this file is laid out:

```
[Hidden]
backup_files=*~
hidden_files=.*
generic_backup_files=*.bak

[Shown]
my_special_backup_file=MyBackup*.bak
```

5 Databrowse Library

The core components of Databrowse that are most directly responsible for building XML representations of files and directories are packaged into Python modules. An interface has been provided that enables Python scripts to leverage the power of Databrowse to quickly obtain XML representations for any file. This is particularly useful in the context of processing scripts written in Python. This is also especially useful in contexts in which the Databrowse plugin responsible for handling a particular type of file provides additional information or meta data that wouldn't otherwise be easily accessible working with the file directly.

The Databrowse library can be imported in Python with the following code:

```
from databrowse.lib import db_lib as dbl
```

The library contains one function named `GetXML`. This function will return the XML representation of a file, as produced by Databrowse.

function dbl.**GetXML**(`filename, output=dbl.OUTPUT_ELEMENT, **params`)

Aguments

filename String containing a relative or absolute path to the file of interest

output Determines the type of output to be returned from the function
- `dbl.OUTPUT_ELEMENT` returns an LXML etree.Element
- `dbl.OUTPUT_ETREE` returns an LXML etree.ElementTree
- `dbl.OUTPUT_STRING` returns a string containing the XML
- `dbl.OUTPUT_STDOUT` prints the XML string to stdout and returns nothing

****params** A variable number of optional parameters that are treated the same way as query string values that would be POST or GET to the web server when Databrowse is being used from the web. Used to pass in various options into plugins.

Usage

```
>>> from databrowse.lib import db_lib as dbl
>>> dbl.GetXML('/tmp/emptyfile', output=dbl.OUTPUT_STDOUT)
<default:default>
  <filename>emptyfile</filename>
  <path>/tmp</path>
  <size>0.0 byte</size>
  <mtime>Tue Sep  3 10:12:40 2013</mtime>
  <ctime>Tue Sep  3 10:12:40 2013</ctime>
  <atime>Tue Sep  3 10:12:42 2013</atime>
  <contenttype>text/plain</contenttype>
  <permissions>-rw-rw-r--</permissions>
  <owner>user:user</owner>
</default:default>
```

It is also worth mentioning the presence of the function `DebugGetXML` which operates identically to `GetXML`, however, it launches a Python debugger session, enabling the user to step through the code line by line.

6 Databrowse Plugin Format

This section provides documentation on nature of Databrowse plugins. It is intended to provide enough information that skilled users may be able to build or customize their own Databrowse plugins, but it is not intended to be a tutorial. Such material will be produced for Databrowse v1.0.

6.1 Plugin File Structure

Individual plugins are Python packages contained within the `databrowse.plugins` namespace. All plugin names should start with the prefix `db_` (this is a legacy requirement and will be removed in Databrowse v1.0). The file structure of the package should be as follows:

```
db_plugin_name\
      __init.py__
      db_plugin_name.py
      dbs_stylesheet_one.xml
      dbs_stylesheet_two.xml
      handlers.py
```

6.2 File Contents

This section will detail the required contents for each file in the plugin. For the purposes of providing an example, let's say we wish to construct a plugin that simply displays the name of a file to the web page. This section will display the necessary file contents needed to produce such a plugin.

6.2.1 `__init.py__`

This file does not require any contents. Its presence is a trigger to the Python interpreter to search for modules. However, you may find it useful to place a docstring inside this file for usage from the Python console and for documentation purposes. The presence of a copyright statement is strongly encouraged. This file can also be used to initialize variables, though, this usage is strongly discouraged in the context of the WSGI server.

6.2.2 `db_plugin_name.py`

This file must be named with the same name as the folder name. The top of the file should contain a copyright statement. The usage of a docstring at the top of the file is also recommended for identification purposes.

This file must contain a class derived from `databrowse.support.renderer_support.renderer_class` and named identically to the file name. It must have several class variables defined:

`_namespace_uri` A string containing the fully qualified URL referring to the XML namespace for the plugin. Existing Databrowse plugins follow the format `http://thermal.cnde.iastate.edu/databrowse/plugin_name`.

`_namespace_local` A string containing the local abbreviated form of the namespace. You should take care to avoid conflicts with other namespace prefixes.

Several other class variables are automatically initialized to defaults, but may be overridden by declaring them as class variables to your inherited class:

`_default_content_mode` A string identifying the default content mode to be loaded when no content mode is specified. The content mode `full` is frequently used. This serves more as an internal identifier for use within the plugin; however, the content mode `raw` has special meaning. This content mode will prevent the main WSGI script from outputting any content to the user. As a result, you can use the `raw` content mode to serve binary content to the web browser. You must manually set the output headers and return content as appropriate from your plugin per PEP 3333.

`_default_style_mode` A string identifying the name of the stylesheet that should be applied to the content output by default if one is not specified by the end user. This string should not include the `dbs_` prefix. See Section 6.2.3 for more information.

`_default_recursion_depth` A number indicating how deep a plugin operating on a directory should recurse down a directory tree by default. This value is not used by plugins that do not operate on directories but should still be set.

An additional set of class variables will be initialized to contain references to objects used by other portions of Databrowse that may be of convenience or use here:

`_relpath` A string initialized to the file path of the currently requested file relative to the data root with a leading forward slash. These paths are used by Databrowse internally to represent full file paths inside URLs.

`_fullpath` A string initialized to the absolute file path of the currently request file. This path should be used to access the file.

`_web_support` A reference to the instantiated `web_support` class, which contains information about the web server request and the current configuration of Databrowse.

`_handler_support` A reference to an instantiated `handler_support` class, which provides functionality for determining which types of plugins are capable of operating on a particular file. It also provides support functionality to determine the icon used to represent a file.

`_caller` A string that identifies the plugin responsible for the call to this plugin. When set to `databrowse`, the call to the plugin is the result of a direct request from the Databrowse WSGI application. Otherwise, this string will contain the name of the plugin making the recursive call to get content from the plugin. This is most frequently the Directory plugin, which can query a plugin for information about a file. This information can then be displayed by the Directory plugin as a preview of a file's contents.

`_handlers` A list of other plugins that are capable of working with this particular type of file, in order of precedence.

The class must contain at least one function – `getContent`. With the exception of the scenario in which the content mode is set to `raw`, this function must return via with an LXML etree.Element, `None`, or raise an exception. The keyword `None` should only be returned when the plugin is not called by Databrowse, but rather is being called by another plugin. This is normally the desired behavior, unless your plugin needs to return content to a directory plugin. The example contents of `db_plugin_name.py` displayed on the following page will produce an XML document containing the filename of the requested file. The format of the generated XML document is

```
<pn:pn xmlns:pn="http://thermal.cnde.iastate.edu/databrowse/plugin_name">
        <filename>some_file_name.txt</filename>
</pn:pn>
```

if the plugin were called with the filename `some_file_name.txt`. This example plugin is trivial, but provides the framework needed to produce XML representations of any type of file.

```python
#!/usr/bin/env python
################################################################################
## Databrowse:  An Extensible Data Management Platform                        ##
## Copyright (C) 2012-2015 Iowa State University                              ##
##                                                                            ##
## This program is free software: you can redistribute it and/or modify      ##
## it under the terms of the GNU General Public License as published by      ##
## the Free Software Foundation, either version 3 of the License, or         ##
## (at your option) any later version.                                        ##
##                                                                            ##
## This program is distributed in the hope that it will be useful,           ##
## but WITHOUT ANY WARRANTY; without even the implied warranty of            ##
## MERCHANTABILITY or FITNESS FOR A PARTICULAR PURPOSE.  See the             ##
## GNU General Public License for more details.                               ##
##                                                                            ##
## You should have received a copy of the GNU General Public License         ##
## along with this program.  If not, see <http://www.gnu.org/licenses/>.     ##
################################################################################
""" plugins/db_plugin_name/db_plugin_name.py - The Plugin Name Plugin """

from lxml import etree
from databrowse.support.renderer_support import renderer_class


class db_plugin_name(renderer_class):
    """ The Plugin Name Plugin - This plugin is an example """

    _namespace_uri = "http://thermal.cnde.iastate.edu/databrowse/plugin_name"
    _namespace_local = "pn"
    _default_content_mode = "full"
    _default_style_mode = "default_view"
    _default_recursion_depth = 2

    def getContent(self):
        if self._caller != "databrowse":
            return None
        else:
            if self._content_mode == "full":
                xmlroot = etree.Element('{%s}%s' % (self._namespace_uri, self._namespace_local),
                                        nsmap=self.nsmap)
                xmlchild = etree.SubElement(xmlroot, "filename", nsmap=self.nsmap)
                xmlchild.text = os.path.basename(self._fullpath)
                return xmlroot
            else:
                raise self.RendererException("Invalid␣Content␣Mode")
        pass
    pass
```

6.2.3 dbs_stylesheet_name.xml

Plugins can contain any number of XSLT stylesheets that are used to transform the XML content produced by the plugin for a particular file into HTML for display on the web browser. These stylesheet files must be named with the prefix `dbs_` and end with the extension `.xml`. Databrowse will automatically locate all stylesheets located within the plugin named in this format and display them as options to the user in the Databrowse menu. Databrowse will also search for stylesheets inside the data folders placed inside of the `.databrowse/stylesheets/db_plugin_name` folder, enabling the end user to write stylesheets for custom views relevant to a particular set of data.

This file does not contain a complete XSLT stylesheet. Rather, it contains XSLT template snippets which will be combined with other snippets from other plugins that may be producing content displayed on the page at any given time. This is particularly important in the context of a directory plugin that is displaying representations of many different files contained within that directory.

This file also does not produce a complete web page. Rather, it should be written such that it writes out HTML snippets, which will be placed in the appropriate location on the web page.

The construction of an XSLT template and the usage of HTML is outside of the scope of this document. Please refer to one of many tutorials on the topics available on line.

The following is an example of an XSLT stylesheet that could be used to transform the content produced by the discussed plugin into HTML.

```
<xsl:template xmlns="http://www.w3.org/1999/xhtml"
      xmlns:pn="http://thermal.cnde.iastate.edu/databrowse/plugin_name"
      xmlns:xsl="http://www.w3.org/1999/XSL/Transform" match="pn:pn" mode="full">
    <h1><xsl:value-of select="filename" /></h1>
</xsl:template>
```

6.2.4 handlers.py

Plugins must contain a `handlers.py` file. This file should contain one function with a name starting with the prefix `dbh_`. The name of this function will be used to determine the order of precedence in ascending order in the case in which multiple plugins can operate on a file. This function receives three parameters:

`path` A string containing the full path to the file that has been requested.

`contenttype` A string containing the RFC 2045 compliant MIME type.

`extension` A string the portion of the filename after the final period or empty if there is no period in the filename.

The return from this function should either be the name of a plugin capable of responding to a request for the given file or `False` otherwise.

Returning to the previous example, a `handlers.py` file for our example plugin might look like the file displayed below. The displayed code will result in this plugin being able to respond to any file with the `.txt` extension.

```
#!/usr/bin/env python
##############################################################################
## Databrowse:  An Extensible Data Management Platform                      ##
## Copyright (C) 2012-2015 Iowa State University                            ##
##                                                                          ##
## This program is free software: you can redistribute it and/or modify     ##
## it under the terms of the GNU General Public License as published by     ##
## the Free Software Foundation, either version 3 of the License, or        ##
## (at your option) any later version.                                      ##
##                                                                          ##
## This program is distributed in the hope that it will be useful,          ##
## but WITHOUT ANY WARRANTY; without even the implied warranty of           ##
## MERCHANTABILITY or FITNESS FOR A PARTICULAR PURPOSE.  See the            ##
## GNU General Public License for more details.                             ##
##                                                                          ##
## You should have received a copy of the GNU General Public License        ##
## along with this program.  If not, see <http://www.gnu.org/licenses/>.    ##
##############################################################################
""" plugins/handlers/dbh_plugin_name.py - Handler for the Plugin Name plugin """


def dbh_plugin_name(path, contenttype, extension):
    """ Plugin Name Handler - Responds to *.txt files"""
    if extension == "txt":
        return "db_plugin_name"
    else:
        return False
```

7 Included Databrowse Plugins

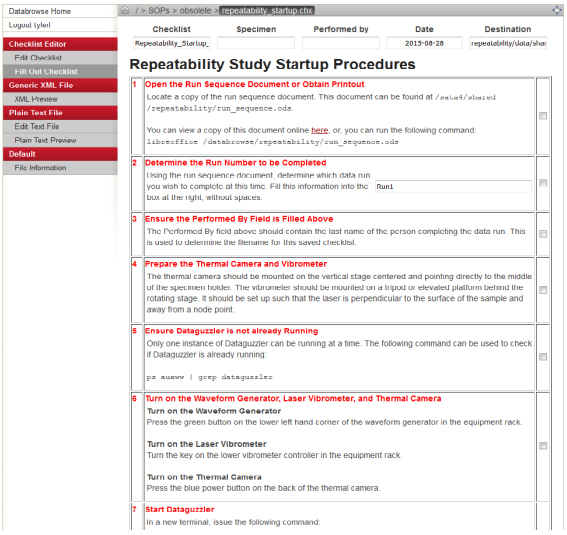
This section details the various plugins that are included with Databrowse for working with a variety of different file types. Documentation in this section is a work in progress. For the time being, simple descriptions of each plugin have been provided.

7.1 Checklist Editor

The checklist editor plugin is one of several Databrowse plugins that were constructed to create and modify data. Checklists (*.chx for checklist templates and *.chf for filled checklists) are XML files that contain the necessary information to document laboratory procedures. The complete details of the file format are outside of the scope of this document. However, this plugin enables the user to open a checklist template, fill out a checklist, and save the filled checklist to the file system.

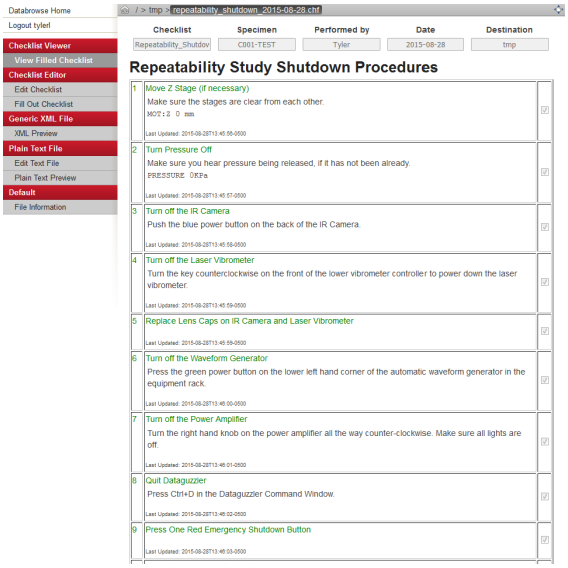
An experimental tool for modifying a checklist is being developed as well. This tool utilizes the Axel XML JavaScript library (`http://ssire.github.io/axel/`) to provide an interface for editing the file in the web browser.

This plugin is not intended to be used from within the Databrowse library interface.



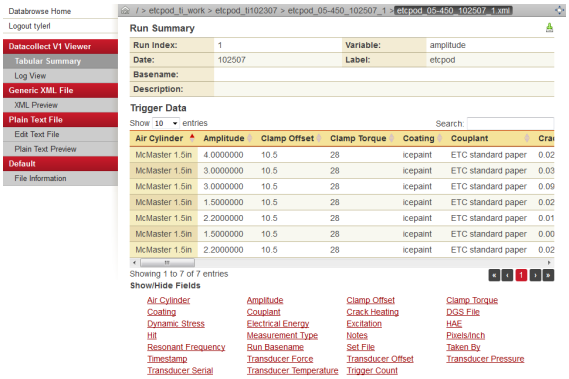
7.2 Checklist Viewer

The checklist viewer plugin displays filled checklist files (*.chf). Checklists (*.chx for checklist templates and *.chf for filled checklists) are XML files that contain the necessary information to document laboratory procedures. The complete details of the file format are outside of the scope of this document. However, this plugin will display the status of all checklist items, along with displaying time stamp information and notes.



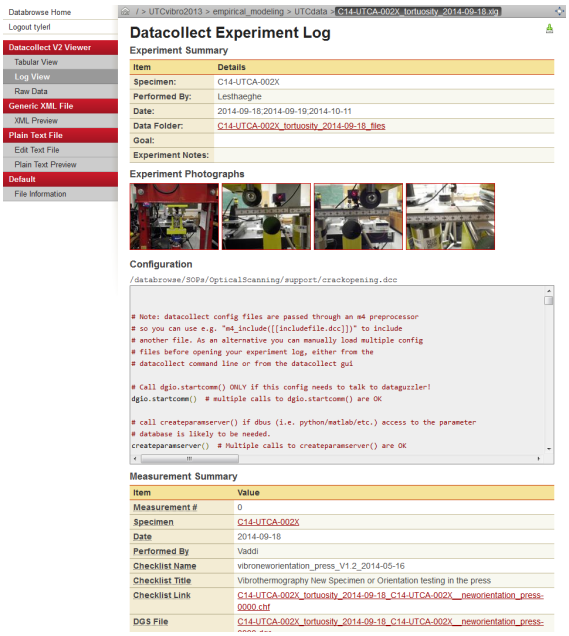
7.3 Datacollect v1 Viewer

Datacollect is a tool that enables the automation of data collection processes. Version 1 of Datacollect provides an interface for the entry of experimental parameters and an interface to aid in automating use of data acquisition tools. This plugin is responsible for displaying the data saved by Datacollect in a meaningful fashion. It can display data in both a log-style format and in a tabular form, capable of being sorted, filtered, and searched.



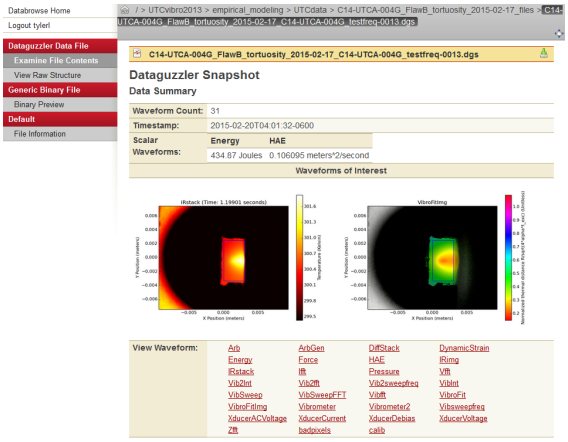
7.4 Datacollect v2 Viewer

Datacollect is a tool that enables the automation of data collection processes. Version 2 of Datacollect provides an interface for the entry of experimental parameters, an interface to aid in automating use of data acquisition tools, and an interface for managing experimental processes and procedures. This plugin is responsible for displaying the data saved by Datacollect in a meaningful fashion. It can display data in both a log-style format and in a tabular form, capable of being sorted, filtered, and searched.



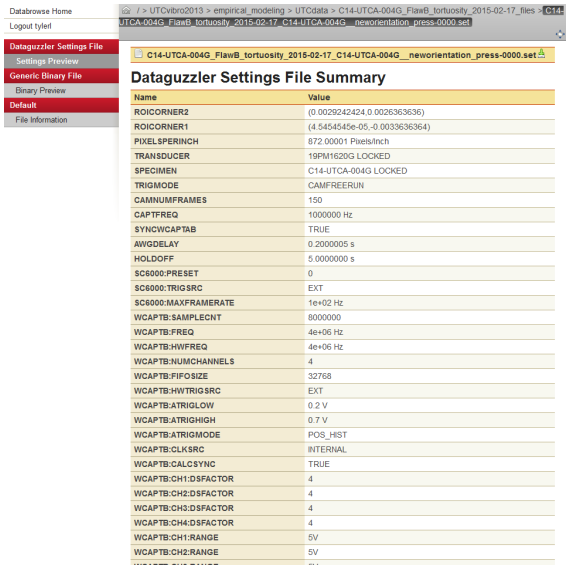
7.5 Dataguzzler Data File

Dataguzzler is an open source extensible data acquisition platform – providing a high speed mechanism for data capture, storage, and visualization. Dataguzzler also provides bindings enabling simple integration with data collection automation scripts and other related programs. The Dataguzzler data file plugin for Databrowse enables the user to view the data contained within Dataguzzler binary data files (*.dgs, *.dgd, *.dga, *.dgz). The plugin utilizes Matplotlib for Python to produce realtime visualizations of data, in addition to displaying all of the associated meta data. The plugin can also export data from Dataguzzler data files into several other common file formats, including CSV and MAT. The plugin is also capable of exporting videos from the appropriate types of data.



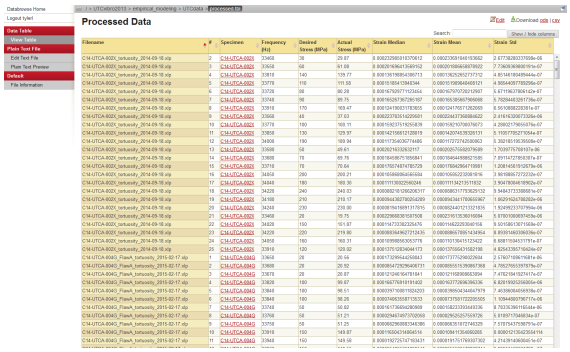
7.6 Dataguzzler Settings File

Dataguzzler is an open source extensible data acquisition platform – providing a high speed mechanism for data capture, storage, and visualization. Dataguzzler also provides bindings enabling simple integration with data collection automation scripts and other related programs. The Dataguzzler set file plugin for Databrowse enables the user to examine the contents of Dataguzzler settings files (*.set).



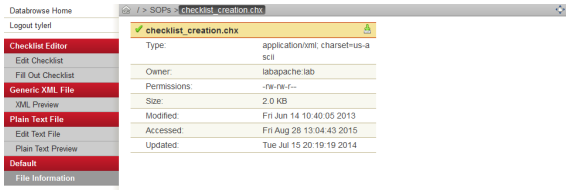
7.7 Data Table

The data table plugin is a tool designed to aid in the collection and compilation of large data sets from multiple sources. This plugin operates on *.tbl files. The exact schema of the *.tbl file is outside of the scope of this document; however, the tbl file is an XML file which instructs the Data Table plugin where to find data files and how to select data from them. The end result is a new XML document that combines all of this data together. This XML document can then be rendered by Databrowse in the web browser in the form of a searchable, sortable, and filterable table. This table can be exported to CSV from the web browser as well. Additionally, this plugin can prove to be very powerful when utilized inside of a processing script using the Databrowse library, enabling rapid development of data processing scripts that can operate on large sets of data in real time.



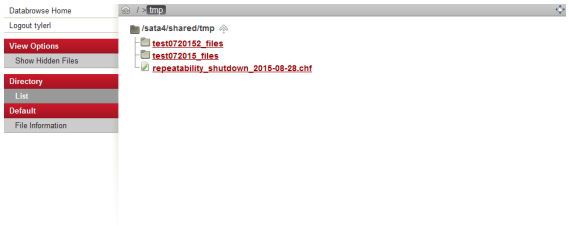
7.8 Default

The default plugin is a catch-all plugin that can operate on any type of file. This ensures that even for files in which Databrowse is unable to determine the appropriate plugin to use, or a plugin does not exist that supports a particular file type, some set of information about the file can be returned and displayed. This plugin will extract basic file information, such as file name, size, timestamps, and permissions.



7.9 Directory

The generic directory plugin is capable of scanning a folder and building an XML representation of the contents of that folder. It is also capable of recursively building a representation of entire directory trees. In the web interface, this is displayed as the default file browser view. The web browser interface has a number of useful features that enable the user to perform operations on files. See Section 3 for additional information about this interface.

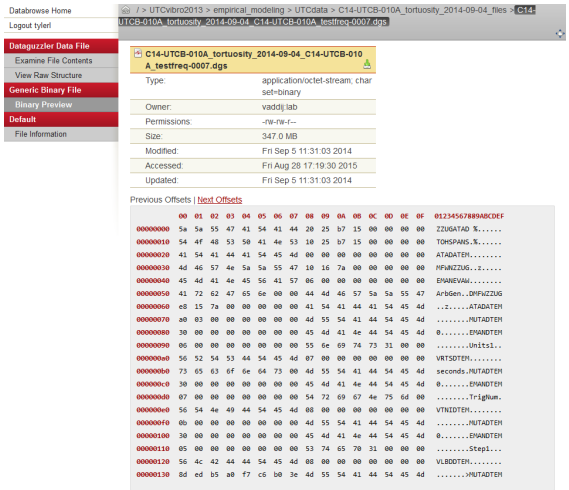


7.10 File Operations

The file operations plugin is a special plugin that is normally not visible from the web or library interface. This plugin enables other plugins to perform special operations on files, particularly those that do not yet exist.

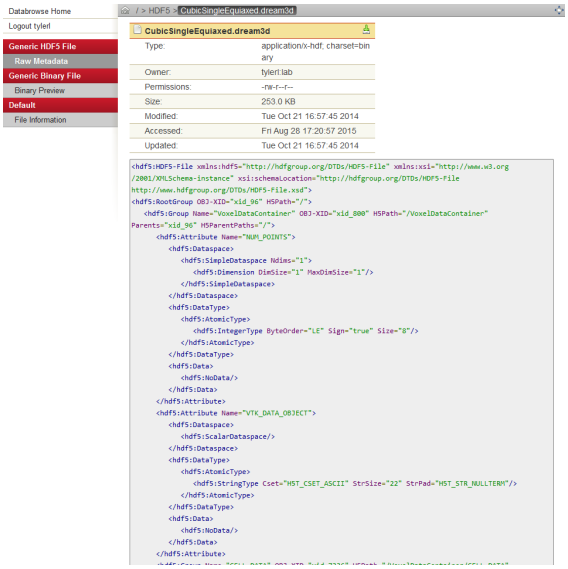
7.11 Generic Binary File

The generic binary file plugin is capable of reading out data in a hex and ASCII format from a binary data file. In the web interface, generic information is displayed about the file, along with an interactive hex viewer tool. The viewer will only pull in a small chunk of the file at a time, since binary files can be rather large. AJAX requests are made by the web browser enabling the user to browse through the file interactively in real time.



7.12 Generic HDF5 File

The HDF5 viewer plugin is a work-in-progress plugin that will simply display the internal structure of an HDF5 file at this time.

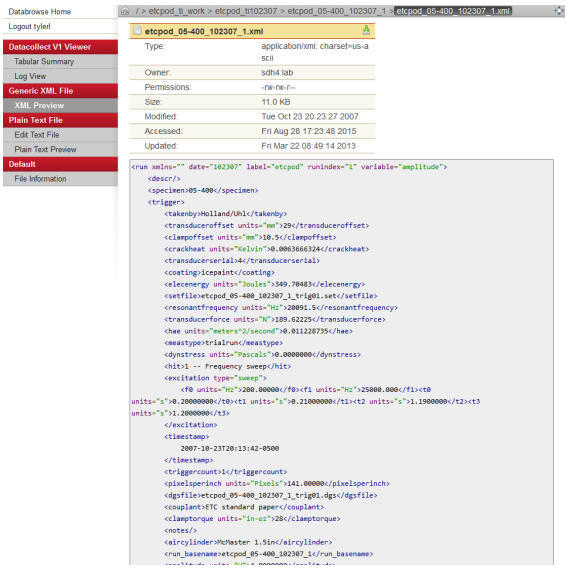


7.13 Generic WSGI Application

The generic WSGI application plugin will enable a WSGI compliant Python script to be ran inside the context of Databrowse. This is very useful for scenarios in which an end user wishes to quickly create an interactive web application within the context of a particular set of data or for a task-oriented purpose without the need to create an infrastructure in which that application will run.

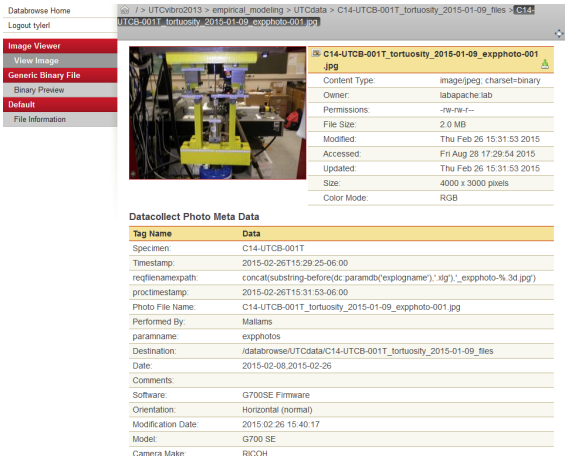
7.14 Generic XML File

The generic XML file viewer will display a textual view of an XML file, along with basic file information.



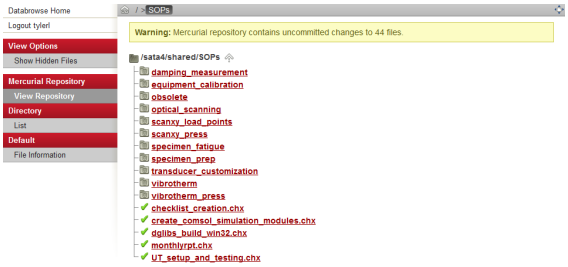
7.15 Image Viewer

The image viewer plugin will display an image, in addition to all internal metadata and EXIF tags associated with an image. The plugin also supports the ability to resize images in real time for use by other plugins as well. It will operate on any file type supported by the Python Imaging Library, including *.png, *.jpg, *.bmp, and many more.



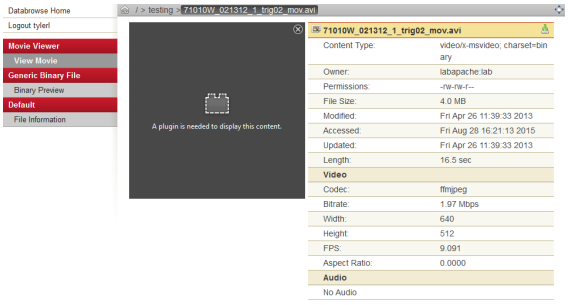
7.16 Mercurial Repository

Mercurial is a version tracking tool. The Mercurial Repository Databrowse plugin is a work-in-progress that will display warning information to users about uncommitted changes and other potential concerns associated with a Mercurial repository. This plugin overrides the default Directory plugin, though, all other functionality available from the directory plugin is still available in this context.



7.17 Movie Viewer

The movie viewer plugin is an experimental plugin that will attempt to stream video content to the users web browser. This requires the usage of the appropriate plugins and codecs on the end user computer. This plugin is also capable of extracting preview frames from videos. It will operate on any video format supported by FFMPEG.

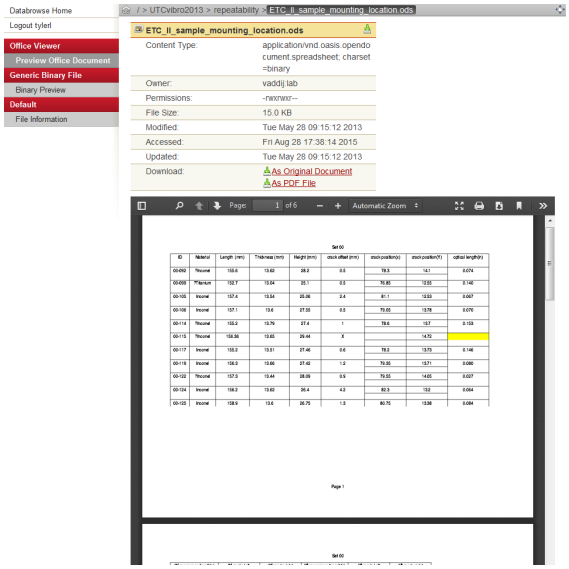


7.18 Multimedia Directory

The multimedia directory plugin will display thumbnail previews of image, video, and other multimedia content. It will override the default directory plugin when the majority of the content inside of a folder can be displayed with a thumbnail preview. Clicking on a thumbnail in the multimedia directory plugin will display a larger version of the image without leaving the page.

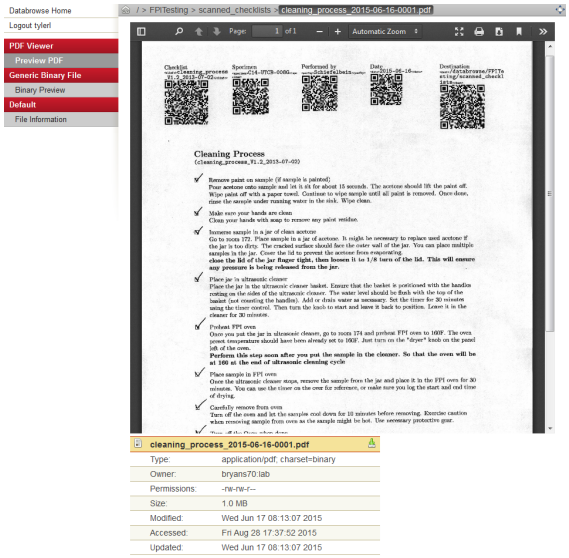
7.19 Office Viewer

The office viewer plugin provides an in-browser PDF preview of word processor documents, spreadsheets, presentations, and other document files. This plugin operates on any file format supported by LibreOffice, including *.doc, *.ppt, *.xls, *.odt, *.odp, *.ods, and many others.



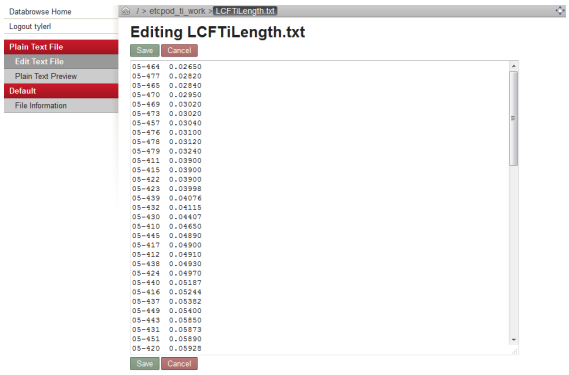
7.20 PDF Viewer

The PDF viewer plugin will display a PDF file for the user inside the web browser.



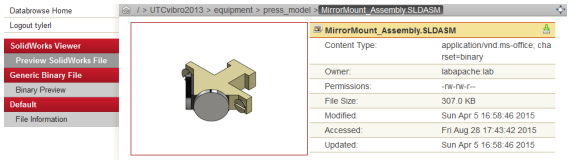
7.21 Plain Text File

The plain text file plugin displays the contents of any plain text file inside the web browser. It also provides a convenient interface for editing plain text files right in the web browser. Backups will automatically be saved by this plugin during a save operation. It will operate on all files with the content-type of plain/text.



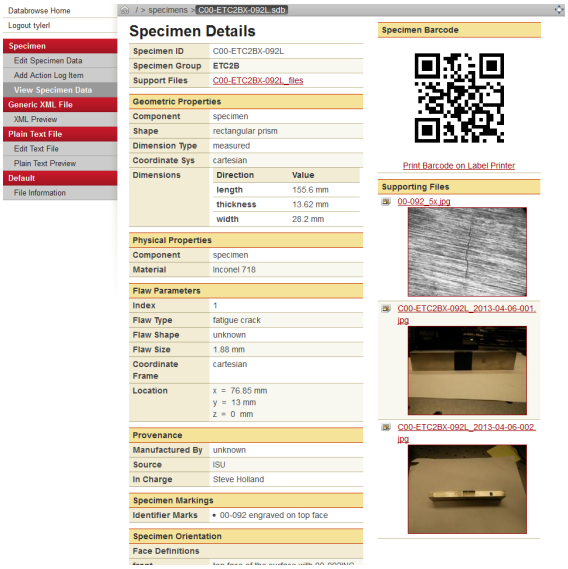
7.22 SolidWorks Viewer

The SolidWorks viewer plugin provides a quick low resolution image preview of a SolidWorks file in the web browser. This plugin is also capable of providing a thumbnail for use in the context of the multimedia directory plugin and other plugins where appropriate. It operates on files with the *.sldprt, *.sldasm, and *.slddrw extensions.



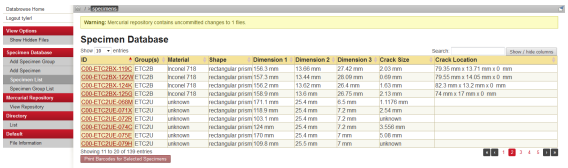
7.23 Specimen Management Plugin

The Specimen Management plugin provides an interface for storing and tracking information about specimens. Operating on XML files containing the *.sdb extension, it can produce a visual display of the details of a specimen, including identification, geometry, provenance information, images, bar code labels, etc. Additionally, utilizing the Axel XML JavaScript library (`http://ssire.github.io/axel/`), this plugin can also provide a web-based interface to edit the details of a specimen on an interactive form. The structure of the sdb files are outside of the context of this document. Templates that control the display and editing of specimen files can be modified, enabling the introduction of new parameters. This plugin is also capable of combining multiple sources of data about a specimen into one unified representation, highly useful both on the web and in the context of the Databrowse library. This capability is presently being used to enable specimens to be placed into specimen groups – sharing all of the parameters from the group and thus limiting the unnecessary repetition of data across many files.



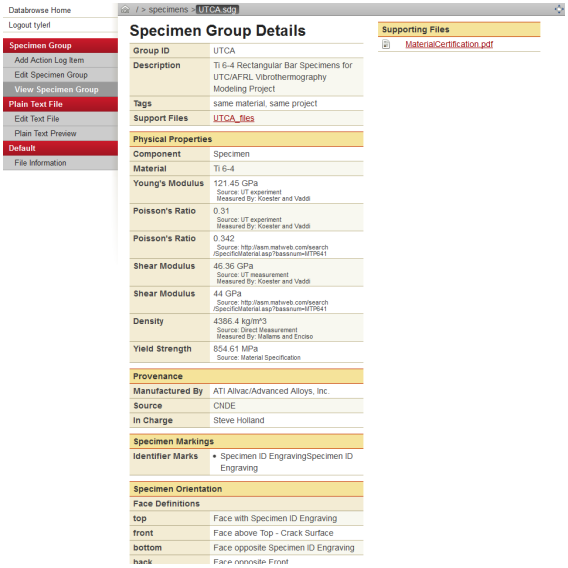
7.24 Specimen Directory Plugin

The Specimen Directory plugin is a complementary tool to the Specimen Management plugin, overriding the directory plugin on directories that contain *.sdb files. This plugin displays a tabular view of specimen parameters, enabling the quick searching, filtering, and sorting of entire sets of specimen data. This plugin also provides easy access needed to create new *.sdb files in the current location.



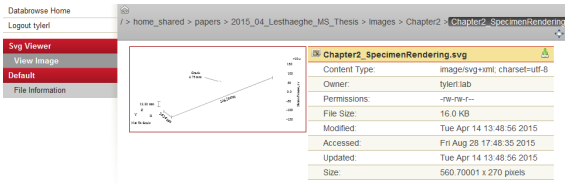
7.25 Specimen Group Management Plugin

The Specimen Group Management plugin is a complementary tool to the Specimen Management plugin, providing similar functionality, but acting in the context of *.sdg files. The schema defining the *.sdg file is outside of the context of this document; however, it is similar in structure to the *.sdb file.



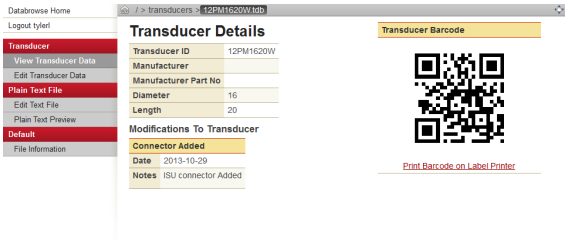
7.26 SVG Viewer

The SVG viewer plugin adds the necessary support to ensure that *.svg vector graphics image files can be displayed on all web browsers, producing an image thumbnail and preview if necessary. It also produces thumbnails for the multimedia directory plugin and in other contexts as needed.



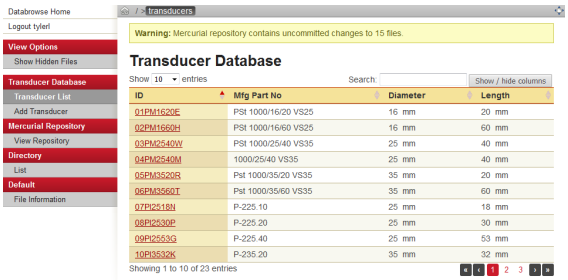
7.27 Transducer Management Plugin

The Transducer Management plugin is similar in functionality to the Specimen Management plugin, but designed in the context of managing parameters and other information associated with ultrasonic transducers. The plugin operates XML files with the extension *.tdb. The structure of these files is outside of the context of this document.



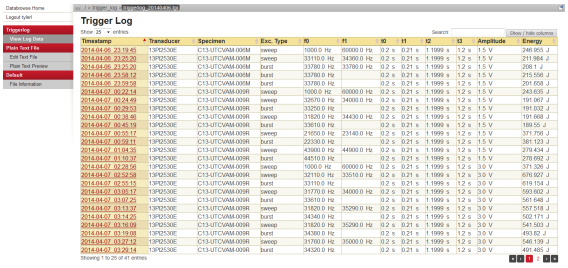
7.28 Transducer Directory Plugin

The Transducer Directory plugin is similar in functionality to the Specimen Directory plugin, overriding the directory plugin on directories that contain *.tdb files, and providing a tabular view of the data contained within, enabling rapid searching, sorting, and filtering.



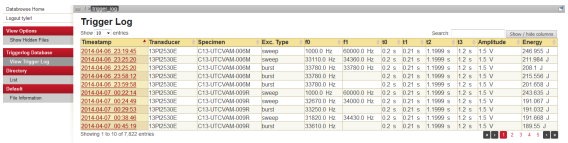
7.29 Trigger Log Plugin

The Trigger Log plugin is similar in functionality to the Transducer Management plugin, but designed in the context of tracking the usage of ultrasonic transducers. An interface with data acquisition software ensures that an XML file with the *.tgl extension is recorded to ensure accurate tracking of all experimental triggers. This plugin will display the data from such a file in a tabular form, enabling rapid searching, sorting, and filtering. The structure of the *.tgl file is outside of the context of this document.



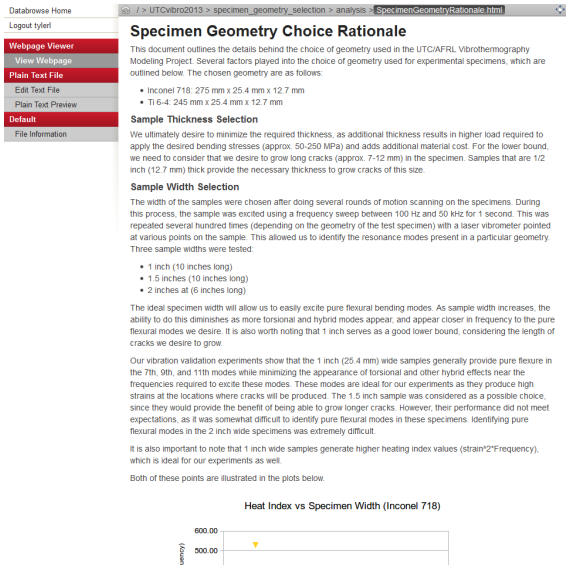
7.30 Trigger Log Directory Plugin

The Trigger Log Directory plugin functions similarly to the Trigger Log plugin, but enabling an entire directory of *.tgl files to be combined into one single representation. This representation is displayed in tabular form, enabling rapid searching, sorting and filtering. This plugin also provides the capability of exporting this data to a CSV file for further analysis.



7.31 Web Page Viewer

The web page viewer plugin will display the contents of an HTML file within the Databrowse interface. Combined with the plain text editor plugin, this plugin can provide a convenient mechanism for documentation while being able to pull together all of the other resources available inside the context of Databrowse.



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Version 3, 29 June 2007

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