Data Retrieval Tools

Test Plan

Jun Peng and Kincho H. Law

Stanford University

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1 About This Test

1.1 Overview (Test Goals)

The goal of this test is for testing the functionality and usability of the developed data retrieval tools. The tools are designed to retrieve project data according to a reference data model developed for shake table and large-scale structural tests (see report NEESgrid-2004-40: Reference NEESgrid Data Model). The web interfaces to the data retrieval tools will be the main testing environment where the functionality of the data retrieval tools can be observed. The test results (observed behavior of software tools) can be compared with the expected behavior, which is specified in the report Data Retrieval Tools Software Design Specification. The data retrieval tools can pass this test only when the observed behavior matches the expected behavior.

1.2 Components Covered by This Test Plan

This test focuses on testing the functionalities of the following software components that are developed to browse and retrieve data related to a project:

- **Project browser** - developed to browse the data and metadata that are related to a particular project.
- **Data retrieval tool** - developed to facilitate retrieving related data from the data repository and to present the data to the users according to a pre-defined file hierarchy.
- **Report generator** - implemented to help organizing project data according to a file hierarchy specified in a report structure.

1.3 Test Environment and Conditions

The following external tools and libraries are employed for the execution of these data retrieval tools:

- Jena API to read, write and manipulate OWL files.
- MySQL database to store data in relational form.
- MySQL Connector J/3.0 (JDBC implementation) to connect Java programs with the MySQL database.
- Java Servlet for retrieving data from the data repository and dynamically generating web pages.

1.4 Reference, Definitions and Acronyms

- **OWL** - Web Ontology Language. OWL is employed to explicitly represent the meaning of terms and the relationships between those terms defined in the
reference data model (NEESgrid-2004-40: Reference NEESgrid Data Model). OWL is represented in XML format. \url{http://www.w3.org/2001/sw/WebOnt/}.

- **Jena** – A Semantic Web Framework for Java. Jena provides a programmatic environment for OWL. By using Jena, OWL documents can be parsed and interpreted. \url{http://jena.sourceforge.net/}.

- **JDBC** – Java Database Connectivity. JDBC is part of the Java Development Kit (JDK) that defines an API (application program interface) to support standard SQL access to databases from Java programs. \url{http://java.sun.com/products/jdbc/}.

2 Approach

2.1 Types of Testing

The usability and functionality of the developed data retrieval tools can be tested without prior knowledge of the internal implementation. After a data server is setup and configured, the data retrieval tools can be accessed via a web interface. Manual testing can be carried out directly using the web interface to browse and retrieve the project data.

2.2 Test objectives

The data retrieval tools need to be tested to verify (1) if the functionalities of the data retrieval tools match the specification; (2) if there is any obvious glitch or broken link; (3) how the data retrieval tools are to be used.

2.3 Performance

System performance will not be tested for current version of the implementation.

3 Features to Be Tested and Not to Be Tested

3.1 Features to Be Tested

The features to be tested include the project browser, a set of data retrieval tools, and the report generator.

3.2 Features Not to Be Tested

As of this writing, the design of the data repository for NEES has yet to be finalized. Therefore, the developed reference data model has not been integrated with the data repository and the data retrieval tools cannot access data from the repository. Instead, a file system and/or a MySQL database system are used to serve as data storage mechanism for the developed data retrieval tools. The integration with NEES data repository will not be tested.
4 Test Execution

4.1 Test Configurations

This section describes the setup and the configurations of the external tools and libraries that are listed in Section 1.3. Please be noted that the following installation instructions are for Windows 2000 or Windows XP systems only. The steps to create or change Windows Environment Variables are:

1. Right-click on ‘My Computer’ at the desktop.
2. Click on ‘Properties’ and then choose ‘Advanced’ from the top menu bar.
3. Click on the button 'Environment Variables...'.
4. There are two windows: one is for ‘System Variables’ and the other is for ‘User variables’. Normally we want to change ‘System Variables’.
5. If we want to create a new environment variable, for example “%CLASSPATH% = C:\java”, we can click on the button ‘New...’. On the pop-up window, enter “CLASSPATH” to the text bar named ‘Variable Name’ and “C:\java” to the text bar named ‘Variable Value’.
6. If we want to change an existing environment variable, for example adding “D:\Tomcat” to the variable “%PATH%”, we can double-clicking the variable “PATH” from the ‘System Variables’ window. Then on the pop-up window, add “D:\Tomcat” to the text bar named ‘Variable Value’.

The following lists the steps to install and configure JDK and Java Servlet:

1. Installation and configuration for JDK (Java Development Kit)
   1.2. Install the downloaded JDK package to your preferred location, such as C:\Program Files\Java.
   1.3. Change the Windows environment variable %JAVA_HOME% to reflect the location where JDK package is installed, such as ‘C:\Program Files\Java’.

2. Installation and configuration for Apache Tomcat Java Servlet
   2.2. Install the downloaded package to a location such as %TOMCAT% = C:\Program Files\Apache Group\Tomcat4.0\common
   2.3. Change the CLASSPATH environment to include: CLASSPATH = C:\Program Files\Apache Group\Tomcat4.0\common\lib\servlet.jar
   2.4. Change the configuration file ‘%TOMCAT%\bin\setclasspath.bat’ by updating the line: ‘set CLASSPATH=%CLASSPATH%;%JAVA_HOME%\lib\tools.jar’

If OWL files are to be employed as data storage, the following lists the steps to install and configure Jena:

2. Unzip and install the downloaded Jena package to your preferred location, such as C:\ Program Files\ Jena.

3. Set a Windows environment variable %JENAROOT% to reflect the location where Jena package is installed, such as C:\ Program Files\ Jena.

4. Set the Java classpath (Windows environment variable %CLASSPATH%) to include all the JAR files in the %JENAROOT%/lib directory:
   J ENAROOT\ lib\ jena.jar
   J ENAROOT\ lib\ xercesImpl.jar
   J ENAROOT\ lib\ xml-apis.jar
   J ENAROOT\ lib\ icu4j.jar
   J ENAROOT\ lib\ concurrent.jar
   J ENAROOT\ lib\ jakarta-or o-2.0.5.jar
   J ENAROOT\ lib\ antlr.jar
   J ENAROOT\ lib\ junit.jar
   J ENAROOT\ lib\ commons-logging.jar
   J ENAROOT\ lib\ log4j-1.2.7.jar
   J ENAROOT\ lib\ rdf-api-2001-01-19.jar

5. Test the Jena installation by running “test.bar” on a Windows Command Prompt.

If MySQL database is to be employed as data storage, MySQL database can be downloaded, installed and configured as follows:

1. Installation and configuration for MySQL Database
   1.1. Download a free MySQL database system from http://www.mysql.com/, the preferred version is 4.1.
   1.2. Install the downloaded MySQL package to your preferred location, such as ‘C:\ Program Files\ mysql’.
   1.3. Setup password for the default user 'root'.
      Mysql> SET PASSWORD FOR root@localhost=PASSWORD('new_password');
   1.4. Delete the default user '' for security reason:
      mysql> DELETE FROM user WHERE Host='localhost' AND User='';
   1.5. Create a new username/password and grant all privileges:
      mysql> GRANT ALL PRIVILEGES ON *.* TO username@localhost IDENTIFIED BY 'password' WITH GRANT OPTION;

2. Installation and configuration for MySQL Connector J/3.0 (JDBC)
   2.2. Unzip the downloaded package to your preferred location, such as ‘D:\ jdbc’.
   2.3. Set the Java classpath (%CLASSPATH%) to include the JAR file.
      For example: CLASSPATH = %CLASSPATH%;D:\ jdbc\ mysql\jdbc\ mysql-connector-java-2.0.14-bin.jar
4.2 Test Data

The data from two pre-recorded earthquake experiments are used in this test. These two experiments are a miniMOST experiment at University of Illinois at Urbana-Champaign and a composite structural frame test at University of Minnesota:

**MiniMOST@UIUC**: The miniMOST experiment equipment was designed to show the capability of the major service components for the NEESgrid using a small-scale physical experiment setup. An experiment has been carried out at UIUC by using miniMOST equipment.

**Composite Frame Test@U of Minnesota**: The primary portion of this experiment is a cyclic loading test on one two-story, one-bay specimen, which represents the bottom two stories of a six-story prototype structure at approximately one-third scale. The steel frame was comprised of W5x19 wide flange columns and W8x13 wide flange beams. The columns and beams were joined through partially-restrained connections, which are comprised of top and seat angles and double web angles.

The data from these two experiments are ingested according to the developed reference data model (see report NEESgrid-2004-40: Reference NEESgrid Data Model). For the object-oriented model, data are ingested using Protégé, which is an open-source software for ontology development (see [http://protege.stanford.edu](http://protege.stanford.edu)). In the two examples, the metadata are saved in two files named `neesmeta_1.2.pprj` and `neesmeta_1.2.owl`.

For the relational data model, SQL scripts are used to create database schema and to ingest data into the MySQL database. Examples of SQL script can be found in `create.sql`, which is used for creating database schema, and `ingestion.sql`, which is used for ingesting miniMOST experiment data. Please be noted that all the aforementioned files are included in the source code release. These files can also be downloaded from [http://eil.stanford.edu/neesgrid/](http://eil.stanford.edu/neesgrid/).

4.3 Test Cases

The developed data retrieval tools can access data from both experiments that are saved in either OWL files or MySQL database. In this test, we will conduct and report the results for the test cases that are marked in the following table:

<table>
<thead>
<tr>
<th></th>
<th>Project Browser</th>
<th>Data Retrieval Tool</th>
<th>Report Generator</th>
</tr>
</thead>
<tbody>
<tr>
<td>miniMOST / OWL</td>
<td>XX</td>
<td>XX</td>
<td>XX</td>
</tr>
<tr>
<td>miniMOST / MySQL</td>
<td></td>
<td>XX</td>
<td>XX</td>
</tr>
<tr>
<td>Composite / OWL</td>
<td>XX</td>
<td>XX</td>
<td>XX</td>
</tr>
</tbody>
</table>
4.4 Test Reports

The following reports the results of the test cases. These tests are conducted via a web browser, and selected screen shots are presented.

1. Project Browser / miniMOST / OWL

Figure 1 shows the main page of the project browser with a list of saved projects. When we click on a particular project, say miniMOST-1, the details of the project will be shown on the browser, as illustrated in Figure 2.

As defined in the reference data model, a Project is a collection (organized group) of Tasks designed to achieve specific goals and objectives. Following the model, we can navigate and access all the Tasks that belong to the Project. Figure 3 shows the details of a particular Task named miniMOST_at_UIUC. One property (or a slot) of a Task object is InfrastructureSetup, which models the assembly and arrangement of the PrimaryEquipment used for a specific Task. We can access the details of the InfrastructureSetup object by clicking on the highlighted button as shown in Figure 3.

Figure 4 shows the details of the InfrastructureSetup, which is a collection of text descriptions, documents (in the format of Word, PDF, Excel, etc.), figures and drawings stored as files. Files are saved in a web server and their URIs are saved as metadata. The files can be dynamically downloaded and shown on a web browser, as illustrated in Figure 5.

![Figure 1 - The Main Page of the Data Browser](https://example.com/figure1.png)
Each Task in a project may contain one or more EventGroups. The EventGroup object can be accessed by clicking the highlighted button shown in Figure 6. The details of a particular EventGroup object named miniMOST_UIUC_EventGroup_2004 are shown in Figure 7.
Figure 4 – Detailed Display of the Infrastructure Setup

Figure 5 – Access of Files Showing the Infrastructure Setup
The Browsing of NEESMeta Objects:

The following is the details of miniMOST_at_UIUC:

<table>
<thead>
<tr>
<th>SLOT</th>
<th>VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>shortDescription</td>
<td>This is the miniMOST experiment at University of Illinois at Urbana-Champaign</td>
</tr>
<tr>
<td>hasSite</td>
<td>UIUC.Site</td>
</tr>
<tr>
<td>hasInfrastructureSetup</td>
<td>miniMOST_overALL_setup</td>
</tr>
<tr>
<td>longDescription</td>
<td></td>
</tr>
<tr>
<td>endDateTime</td>
<td>2004-09-20</td>
</tr>
<tr>
<td>name</td>
<td>miniMOST_at_UIUC</td>
</tr>
<tr>
<td>hasEventGroups</td>
<td>miniMOST_UIUC_EventGroup_2004</td>
</tr>
<tr>
<td>hasPublications</td>
<td></td>
</tr>
<tr>
<td>keywords</td>
<td>miniMOST</td>
</tr>
<tr>
<td></td>
<td>University of Illinois at Urbana-Champaign</td>
</tr>
<tr>
<td>startDateTime</td>
<td>2003-03-01</td>
</tr>
<tr>
<td>localTimezone</td>
<td>CST</td>
</tr>
</tbody>
</table>

Figure 6 – Detailed Display of the Task miniMOST_at_UIUC

Figure 7 – Detailed Display of the EventGroup
An EventGroup is defined as a collection of Events, each of which can be accessed from the EventGroup object. The details of an Event named miniMOST_test_0228 are shown in Figure 8. An Event, which is the atomic level of an Activity, refers to a single run of an experiment or a simulation. Experimental results, such as SensorReading, can be accessed from an Event object, as shown in Figure 9.

Figure 8 – Detailed Display of the Event miniMOST_test_0228

Figure 9 – Access of SensorReading for the Event miniMOST_test_0228
2. Data Retrieval Tool / miniMOST / MySQL

Figure 10 shows the main page of the data retrieval tool in accessing experiment data that are saved in MySQL. A user can choose a project and the category of interest. Once the selection is processed, the retrieved data will be shown on the browser. For example, Figure 11 shows the data related to category “Summary” and Figure 12 shows the data related to category “Instrumentation”.

![Figure 10 – Main Page to Retrieve MiniMOST Data Saved in MySQL](image1)

![Figure 11 – Display of “Summary” for MiniMOST Experiment](image2)
3. Data Retrieval Tools / Composite Frame Test / OWL

Data retrieval tools can also be used to retrieve and organize data saved in OWL files. As shown in Figure 13, a main page is provided to retrieve the experiment data from the composite frame test. Based on the category of interest, certain related data are retrieved and shown on the browser. Figure 14 shows the data related to category “Specimen”. Detailed information about “Specimen” can be accessed from this page, such as a particular drawing of the specimen shown in Figure 15. Similarly, description and detailed information about “Loading System” can be retrieved, as shown in Figure 16 and Figure 17.
The Retrieving of NEESMeta Objects:

Engineering Report Generation Facility:

Please choose the Project first:
Composite_Steel_Frame-RC_Infilled_Wall

Choose the category that you want to download:
1. Summary
   1.1. Scope and general presentation
   1.2. Test setup overview
   1.3. Infrastructure setup
   1.4. Specimen description
   1.5. Loading System
   1.6. Instrumentation
   1.7. Test procedures
   1.8. Test schedule
   1.9. Test implementation
   1.10. Test results

Figure 13 – Main Page to Retrieve Composite Frame Test Data Saved in OWL

The following files are related to general Specimen Drawings:
UMN_Chap3

The following files are related to Specimen Descriptions:
UMN_Figure3.16
UMN_Figure3.15
UMN_Figure3.14
UMN_Figure3.13
UMN_Figure3.12
UMN_Figure3.11
UMN_Figure3.10
UMN_Figure3.9
UMN_Figure3.8
UMN_Figure3.7

Figure 14 – Display of “Specimen” for the Composite Frame Test
Figure 15 – Access of Drawings for the “Specimen”

Figure 16 – Display of “Loading System” for the Composite Frame Test
4. Report Generator

The main page for the Report Generator is shown in Figure 18. The same interface is used for accessing the data saved in either OWL files repository or MySQL database. Once a particular project is chosen, the main interface of the report generator will be shown. As illustrated in Figure 19, the left frame of the main interface displays buttons which represent the categories as defined in the report file hierarchy. Upon clicking on a particular button, the right frame displays the content of that category. For example, Figure 19 shows the miniMOST experiment data related to category “Summary”.

Besides retrieving the project data from the data repository, the Report Generator also supports the scenario where project data are saved in different types of repositories. For instance, miniMOST experiment data are saved in OWL files as well as in a MySQL database. Figure 20 shows the interface to access miniMOST experiment data saved in OWL files, whereas Figure 21 shows the interface to access miniMOST experiment data saved in MySQL database.

Another test case is using the Report Generator to access the composite structural frame test data saved in OWL files. The main interface to access the test data is shown in Figure 22. The content of a particular category can be directly accessed. Figure 23 shows the data related to category “Infrastructure”, Figure 24 shows the data related to category “Loading”, and Figure 25 shows the data related to category “Instrumentation”.

Figure 17 – Access of Drawings for the “Loading System”
Data Retrieval for Engineering Report Generation:

For Data Saved as OWL Files:

Please choose the Project first:

Database:

- neesmeta_HCS82_merge_Instance_44
- miniMOST-1-1
- Composite_Steel_Frame-RC_Infill_Wall
- CURR_Woodframe_Project

Please choose the Project first:

- miniMOST-1

Submit

Figure 18 – Main Page of the Report Generator

Figure 19 – Main Interface of Report Generator for MiniMOST Experiment
Data Retrieval for Engineering Report Generation:

The following files are related to Specimen Setup:

<table>
<thead>
<tr>
<th>SLOT</th>
<th>VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>shortDescription</td>
<td>Specimen setup for MiniMOST experiment.</td>
</tr>
<tr>
<td>longDescription</td>
<td></td>
</tr>
<tr>
<td>hasSpecimens</td>
<td>miniMOST_specimen</td>
</tr>
<tr>
<td>name</td>
<td>miniMOST_specimen_setup</td>
</tr>
<tr>
<td>hasPrimaryEquipments</td>
<td></td>
</tr>
<tr>
<td>setupDescriptions</td>
<td>MiniMost_Visual.pdf</td>
</tr>
<tr>
<td></td>
<td>miniMost_requirements.pdf</td>
</tr>
<tr>
<td>setupFigures</td>
<td>test_setup_planView.pdf</td>
</tr>
<tr>
<td></td>
<td>side_view_actuator_beam.jpg</td>
</tr>
</tbody>
</table>

Figure 20 – Access of “Specimen” for MiniMOST Data Saved in OWL

The related files are as follows:

<table>
<thead>
<tr>
<th>SLOT</th>
<th>VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>specimenSetupID</td>
<td>3000011</td>
</tr>
<tr>
<td>name</td>
<td>miniMOST_uiuc_specimen_setup</td>
</tr>
<tr>
<td>eventGroupID</td>
<td>3000011</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>SLOT</th>
<th>VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>fileID</td>
<td>30000001</td>
</tr>
<tr>
<td>name</td>
<td>miniMOST_requirements.pdf</td>
</tr>
<tr>
<td>type</td>
<td>Adobe Acrobat Document</td>
</tr>
<tr>
<td>description</td>
<td>Describe the setup and requirements for miniMOST experiment.</td>
</tr>
<tr>
<td>authors</td>
<td>UIUC</td>
</tr>
<tr>
<td>dateModified</td>
<td>2004-04-12 01:52:00</td>
</tr>
</tbody>
</table>

Figure 21 – Access of “Specimen” for MiniMOST Data Saved in MySQL
Figure 22 - Main Interface of Report Generator for the Composite Frame Test

Figure 23 - Access of “Infrastructure” Data for the Composite Frame Test
The following files are related to Loading:

The following are related to Loading of EventGroups:

The following files are related to Waveform Setup:

The following is the details of
UN_Composite_infill_wall_LoadHistory:

<table>
<thead>
<tr>
<th>SLOT</th>
<th>VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>shortDescription</td>
<td>The cyclic loading history on the composite infill wall.</td>
</tr>
<tr>
<td>hasWaveform</td>
<td>UN_Composite_infill_wall_LoadHistory</td>
</tr>
<tr>
<td>scaleFactor</td>
<td>1.0</td>
</tr>
</tbody>
</table>

The cyclic loading history is shown in Figure 3.5.1. A total of 25 loading cycles were divided into 3 loading groups. Each group had 3 loading cycles except for the last two groups, which had 2 loading cycles each. The cyclic loading history was modified from SAC protocol for testing of steel beam-column connections and other steel specimens (SAC, 1997). In order to capture the characterization of crack formation and Fig. 3.5.1.

Figure 24 – Access of “Loading” Data for the Composite Frame Test

The following files are related to Instrumentation Setup:

The following is the details of
UN_Composite_infill_wall_SensorSetup_global:

<table>
<thead>
<tr>
<th>SLOT</th>
<th>VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>shortDescription</td>
<td>The setup of instrumentation</td>
</tr>
<tr>
<td>longDescription</td>
<td>The specimen was heavily instrumented in order to obtain comprehensive information. Three types of instruments, including strain gages, linear variable differential transformers (LVDTs), and linear position transducers (LPTs) were employed to measure strains and displacements.</td>
</tr>
<tr>
<td>none</td>
<td>UN_Composite_infill_wall_SensorSetup_global</td>
</tr>
<tr>
<td>setupDescriptions</td>
<td>UN_Composite_infill_wall_SensorSetup_global</td>
</tr>
<tr>
<td>setupFigures</td>
<td>UN_Figure5.4.1</td>
</tr>
<tr>
<td></td>
<td>UN_Figure5.4.2</td>
</tr>
</tbody>
</table>

Figure 25 – Access of “Instrumentation” Data for the Composite Frame Test