

IHAL-BASED INSTRUMENTATION CONFIGURATION MANAGEMENT TOOLS

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ABSTRACT

The Instrumentation Hardware Abstraction Language (IHAL) has been developed to be a neutral language that is focused on the description and control of instrumentation systems and networks. This paper describes the various instrumentation configuration management tools we have designed that make use of IHAL's neutral specification of instrumentation networks. We discuss the features currently present in prototypes as well as future enhancements.

KEYWORDS

Instrumentation, Hardware Abstraction Language, Neutral Format, eXtensible Markup Language, IHAL, Configuration Management.

INTRODUCTION

The Instrumentation Hardware Abstraction Language (IHAL) has been developed to be a neutral language that is focused on the description and control of instrumentation systems and networks. IHAL is designed on the principle that the same language must serve three roles: (1) as a descriptive language for specifying and describing the components and configuration of an instrumentation system, (2) as a command language for issuing configuration and data commands to instrumentation hardware, and (3) as a query language for requesting the current state of instrumentation hardware. The design of the IHAL was presented at the 2006 ITC.

Like any other representational language, IHAL is only beneficial as long as supporting tools exist. Likewise, the various features of IHAL enable the development of numerous software

features and tools that make it easier to design, configure, and evaluate instrumentation networks. We have developed prototypes of two such tools – the Instrumentation Configuration Repository (ICR) and the InstrumentMap – both of which make use of IHAL’s features to simplify the instrumentation engineer’s tasks at different phases of the instrumentation network’s life cycle.

The ICR enables the storage and visualization of an archive of instrumentation configurations. Among the ICR’s features are configuration searching, establishing/viewing relationships between configurations, and attaching/viewing files associated with each configuration. Thus, the ICR aides the instrumentation engineer in reviewing past configurations, either for the purpose of forensics or when looking for an existing configuration to serve as the starting point for defining a new configuration.

The InstrumentMap, on the other hand, enables the user to visualize and modify a single configuration at a time. Its features allow the visualization of multiple networks (e.g., on system under test, at ground station, etc.) at once. The configuration of the instrumentation hardware within the network can be viewed and modified, and an IHAL command file can be generated to update the hardware configuration. An advanced search feature enables the engineer to find suitable replacements for missing or obsolete hardware.

The following sections provide a detailed description of each of these tools, including detailed descriptions of their features.

INSTRUMENTATION CONFIGURATION REPOSITORY (ICR)

The ICR provides the user with a top-level visualization of the configurations stored in one or more IHAL files. The ICR displays each IHAL configuration as a block on the screen. Double-clicking a block will open the InstrumentMap for that configuration.

The ICR allows the user to view and specify relationships between the configurations, view the external files associated with each configuration, search the configurations in the repository, and view and edit the IHAL eXtensible Markup Language (XML) text for each IHAL file. Figure 1 presents a screenshot of the ICR .

The ICR allows the end user to specify a relationship between two configurations and visualize the relationship with an arrow connecting the boxes. In the ICR, clicking the ‘Create Map’ button and then clicking and dragging the mouse from one configuration box to another will create an arrow from the first configuration to the second. These arrows can be used to indicate relationships such as precedence (the first configuration is a previous version of the second) or derivation (the second configuration is a new configuration derived from the first). In the future, this feature could be extended to allow users to indicate the type of relationship and to add a description or explanation.

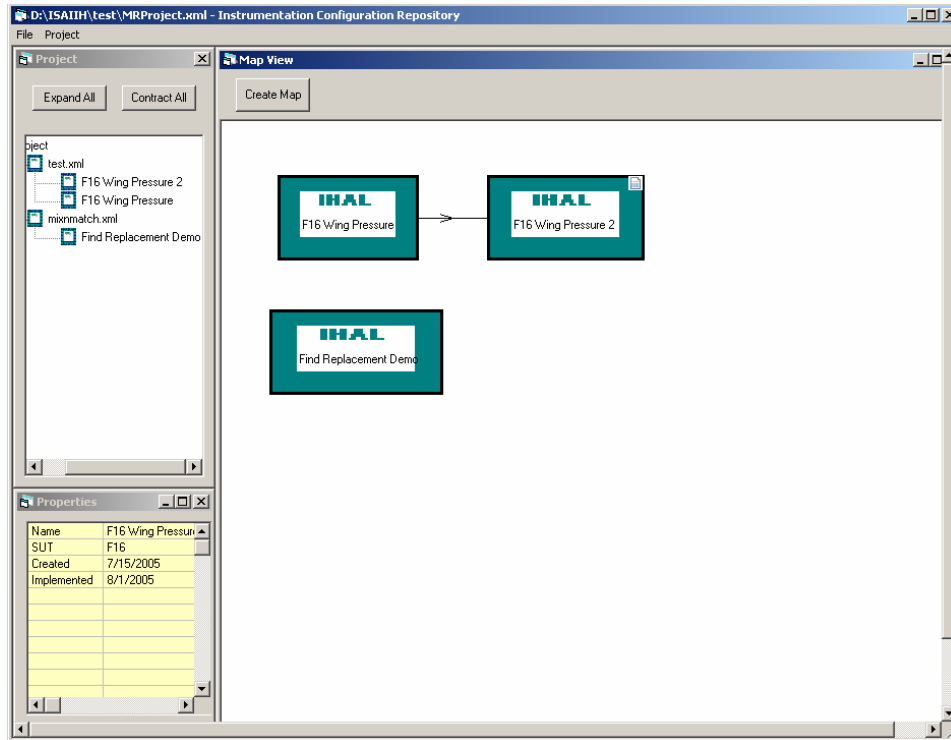


Figure 1 - IHAL Instrumentation Configuration Repository

ICR SUPPORT FOR ASSOCIATING EXTERNAL FILES

The ICR detects the presence of <file> elements associated with each IHAL configuration and displays an icon on the box for those configurations that have associated files. Right-clicking this icon displays a menu that allows the user to open a dialog listing all of the files associated with that configuration. The Associated Files dialog lists each file's name, description, and location. If the file's location is a network or local path accessible by the user's computer, the file can be opened in its associated application from this dialog. Figure 2 shows a configuration that has the associated files icon along with the right-click menu for viewing the file list. Figure 3 shows the Associated Files dialog, which is opened when 'View Files...' is chosen from the right-click menu. This functionality is useful for associating data files as well as external notes, memos, etc. that serve as design rationale for the instrumentation network.



Figure 2 - Right-click Menu for Viewing Attached Files in ICR

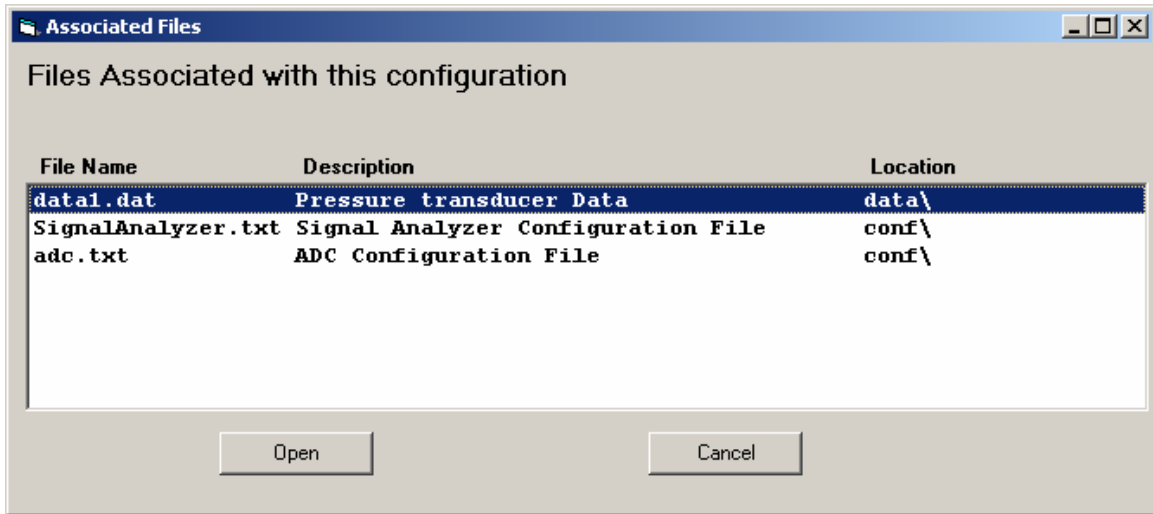


Figure 3 - Associated Files Dialog in ICR

ICR SEARCH CAPABILITY AND PREVIEW/EDIT OF IHAL XML

The ICR also has the ability to search the configurations within the repository based on several criteria. Configurations can be searched based on the date they were created, the date they were implemented, the type of instruments used, and the presence of certain words or phrases. The query is performed using XQuery, a language designed for querying XML files similar to the way SQL is used to query databases. The result of the query is an XML file that lists all of the configurations that match the search criteria along with the IHAL file(s) where they are located.

Configuration searching in the ICR is performed through the Query dialog, which is shown in Figure 4. This dialog is accessible through the File | Query... menu option. From this dialog, the user can specify any combination of the available search criteria.

Text searches can be performed either on configuration attributes or on descendant elements. The 'High-level Objects' option allows the user to search for configurations that contain a minimum number of certain instrument type uses. After a search is performed, the resulting XML file is displayed in the 'Results' portion of the dialog.

The ICR also allows the user to open the IHAL XML text either in a read-only browser or in a text editor window. Both of these windows allow the user to conveniently view the actual IHAL code contained in each IHAL file in the repository. The browser window functions similar to a web browser's XML viewing functionality, color-coding the different parts of the XML file and allowing the user to expand and collapse each node. The text editor allows the user to add, edit, and delete the text.

Figure 5 shows the ICR with the IHAL viewer activated for one of the IHAL files in the repository. This window is accessible through the 'Preview...' option on the configuration right-click menu. The text editor window is accessible through the 'Edit Text...' option from the same menu.

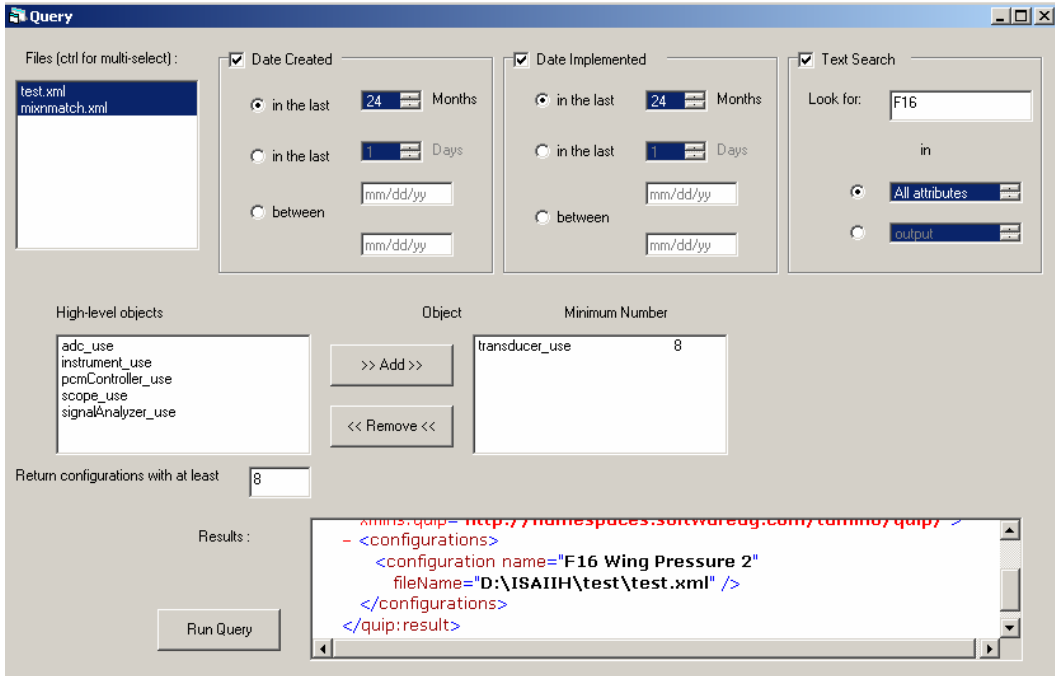


Figure 4 - ICR Query Dialog

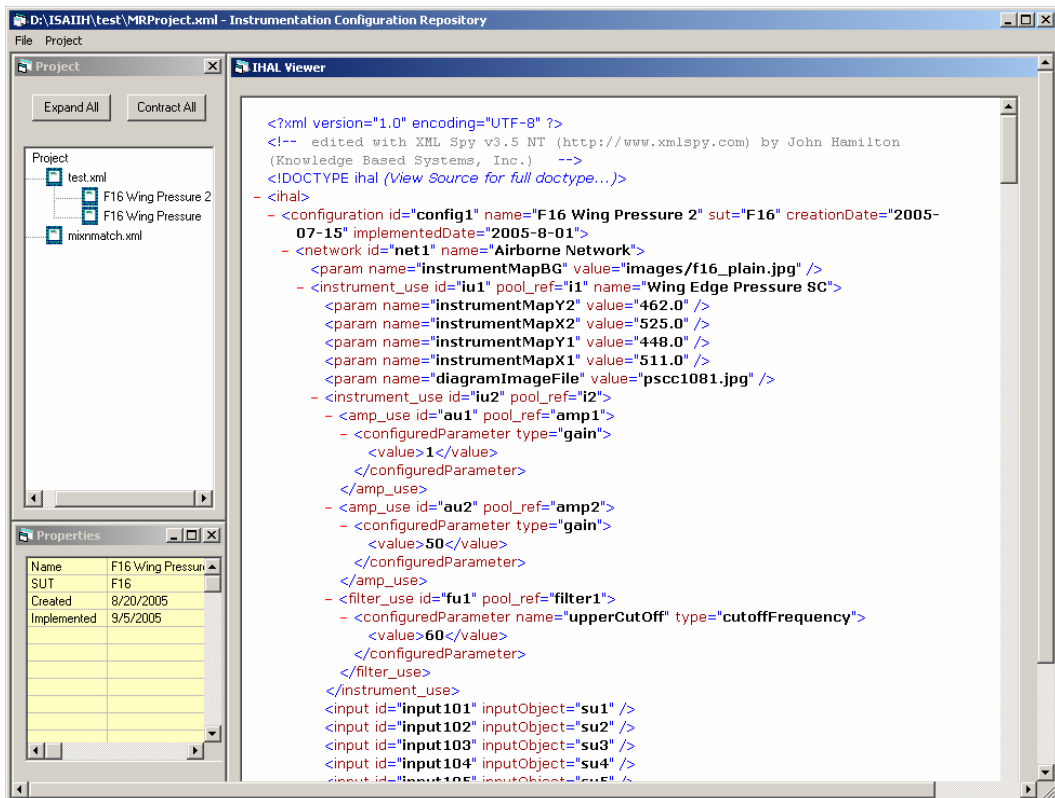


Figure 5 - ICR Window showing the IHAL Viewer Pane

INSTRUMENT MAP

The InstrumentMap is a Java application that lets the user visualize and control a single IHAL configuration. The application consists of a four-panel display that allows the user to view details of the components in the configuration, including the various networks and the hardware used in them. In addition to useful visualization features such as the multi-panel display, display of supporting images for various components, and display filtering, InstrumentMap also provides valuable control features such as instrument configuration and control and an instrument replacement search. A screenshot of InstrumentMap is presented in Figure 6.

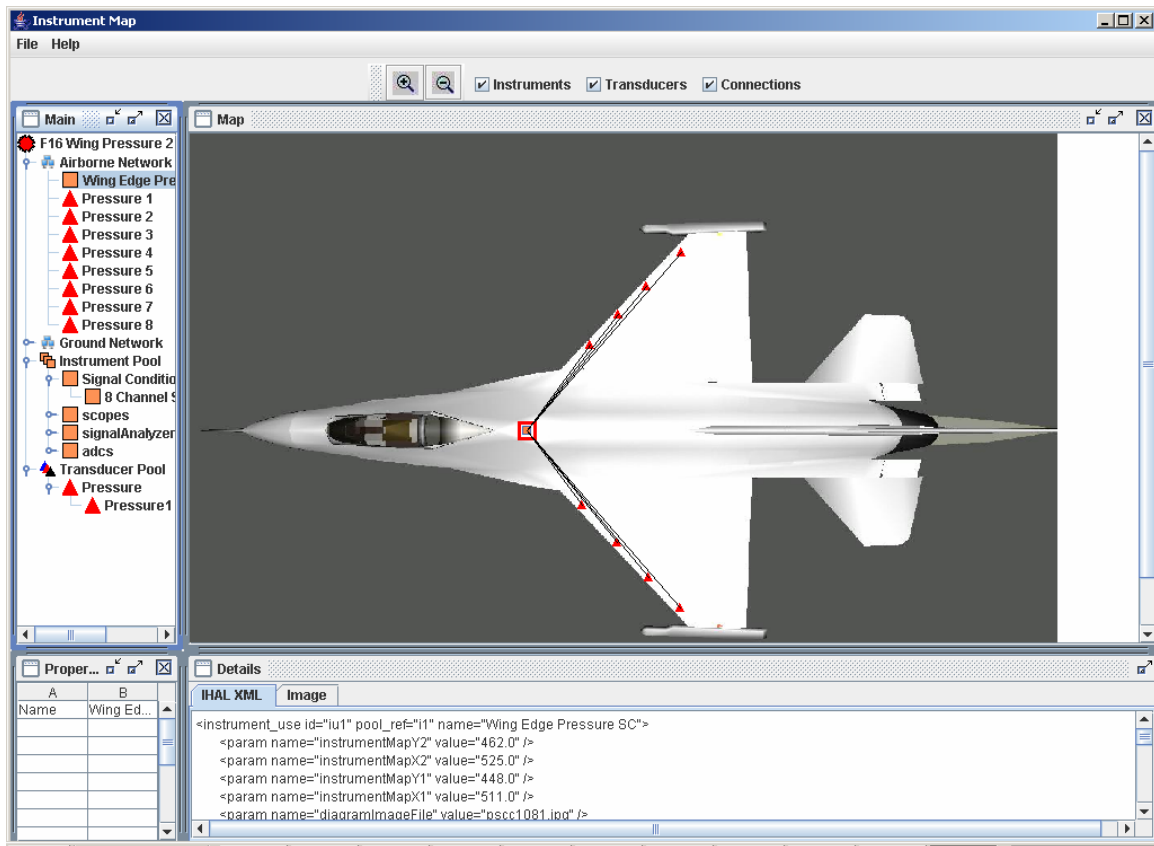


Figure 6 - ISAIH InstrumentMap Application

The InstrumentMap display divides the information in a configuration among four panels: tree panel, property panel, map panel, and detail panel.

The tree panel (top left) contains a hierarchical list of all the components in the configuration, as well as the complete pools from the IHAL file. The configuration information displays each network as a node in the tree, with sub nodes representing the various instrument and transducer uses contained in the network. In each pool, the instruments, transducers, and buses in that pool

are grouped by type. Selecting an item in the tree panel displays more information about that item in the other three panels.

The property panel (bottom left) consists of a table that displays various properties and their values for the currently selected object in the map or tree panel. For example, when the user selects an instrument use in the tree or map panels, the attributes of that instrument use will be listed in the property panel. The name of each property is listed in the left column, with the corresponding property value listed in the right column.

The map panel (top right) displays the instruments, transducers, buses, and the connections among them in the selected network, showing them graphically superimposed on a background image of their location. The user can click and drag on the instruments and transducers in the map panel to relocate them. This position information can then be saved by choosing File | Commit from the menu. When an instrument or transducer is selected on the map panel, it will automatically be selected on the tree as well, and vice versa.

The detail panel (bottom right) provides further details about the currently selected item. When an instrument, instrument use, transducer, or transducer use is selected in the map or tree panel, the detail panel will appear. The detail panel contains two tabs. One tab displays the IHAL XML text, while the other tab displays an image, if available, of the currently selected item.

InstrumentMap is capable of displaying more than one network. The networks contained in the configuration are listed in the tree panel. If a user is viewing one network and then selects a different network or subcomponent in a different network, the map panel will immediately switch to displaying the newly selected network. The zoom level of the map panel for each network is maintained and restored as the user switches among them.

Several check boxes appear in the InstrumentMap that allow the user to filter the types of components displayed in the map panel. With these checkboxes, the user can toggle on and off the display of instruments, transducers, and connection lines. The check boxes are located at the top of the InstrumentMap window in the toolbar, as seen in Figure 6. If instruments or transducers are made invisible by filtering them out of view, then any connection lines attached to them will also disappear.

SUPPORT FOR IMAGES OF INSTRUMENTS AND NETWORKS

InstrumentMap supports the association of images with instruments, instrument uses, and networks. Each network can have an associated image that will serve as the background image when viewing the network in InstrumentMap.

In addition, each instrument and instrument use can have an associated image as well. These images will appear on the 'Image' tab of the detail panel when the corresponding instrument or instrument use is selected.

In order to associate images with networks and instruments, InstrumentMap makes use of the custom parameter (<param>) element in IHAL. When InstrumentMap loads an IHAL file, it looks for special instrument map-specific <param> elements with the names

“diagramImageFile” and “instrumentMapBG.” These elements specify the paths to the image files associated with instruments and networks, respectively. An example of displaying an image in the lower right panel of InstrumentMap is shown in Figure 7.

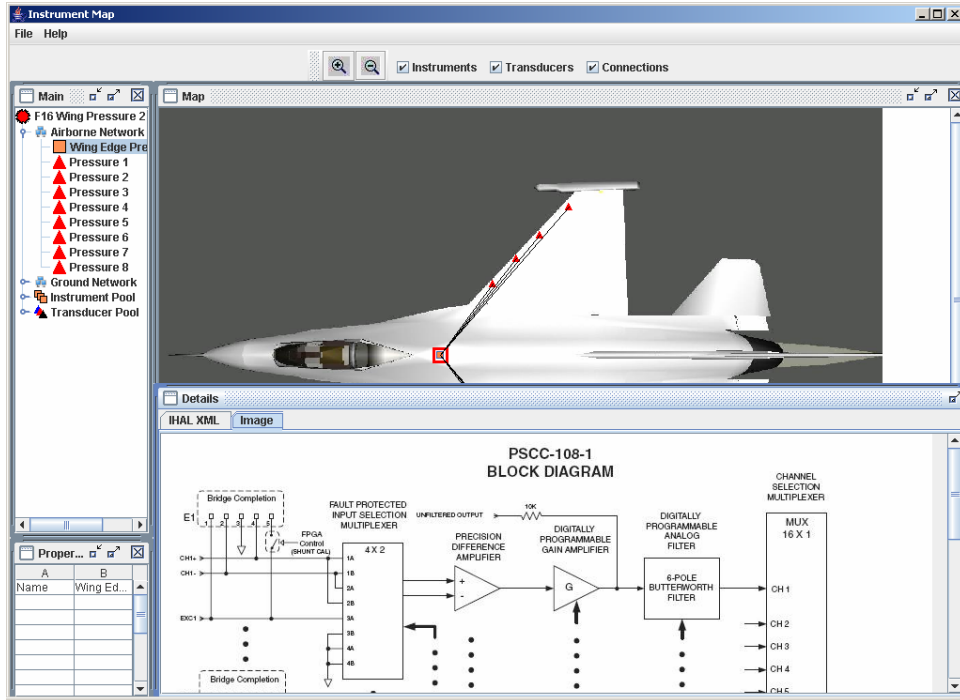


Figure 7 - Supporting Images of Instruments and Networks in InstrumentMap

ICR AND INSTRUMENTMAP INTEGRATION

The ICR has been loosely integrated with the InstrumentMap tool. When the user double-clicks on a configuration box in the ICR, the InstrumentMap tool launches and loads that configuration. This can be done multiple times, allowing several configurations to be open in separate InstrumentMap windows at the same time.

CONCLUSIONS

We have described two applications that make use of IHAL’s neutral specification of instrumentation networks – the Instrumentation Configuration Repository and the InstrumentMap, both of which support the editing, management and support of IHAL models.