



Requirements Decomposition Analysis

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Requirements Decomposition Analysis

Task Description

- **Problem Statement:** Requirements play a pivotal role in planning, selection, development, testing and operation of NASA's missions. Starting from mission objectives, requirements are successively decomposed. The correctness of this decomposition is critical, yet V&V of this crucial step is limited to manual inspection and pointwise testing, which are cumbersome and fallible (e.g., Mars Polar Lander).
- **Task:** Rigorous lightweight analysis methods for requirements decomposition have been developed by the software engineering research community, and have shown promise in successful application to critical systems (e.g., rail transportation). This proposal will study their application to the V&V of spacecraft software requirements, to ascertain if, when and how they are suitable for use by NASA.



Requirements Decomposition Analysis

Goals and Objectives

- **Goal:** study the applicability to NASA spacecraft requirements of rigorous analysis methods for requirements decomposition that have been developed by the software engineering research community.
- **Objectives:**
 1. **M**anually apply decomposition analysis methods applied to spacecraft requirements.
 2. Based on the results of of these application studies, emerge with recommendations for the application of these methods, identify needed extensions to those methods, and indicate the opportunities for their support (e.g., via checklists, procedures and/or tool support).
 3. Develop the most promising support approaches identified by the first phase to make them suitable for application to NASA's spacecraft requirements.



Requirements Decomposition Analysis

Highlights

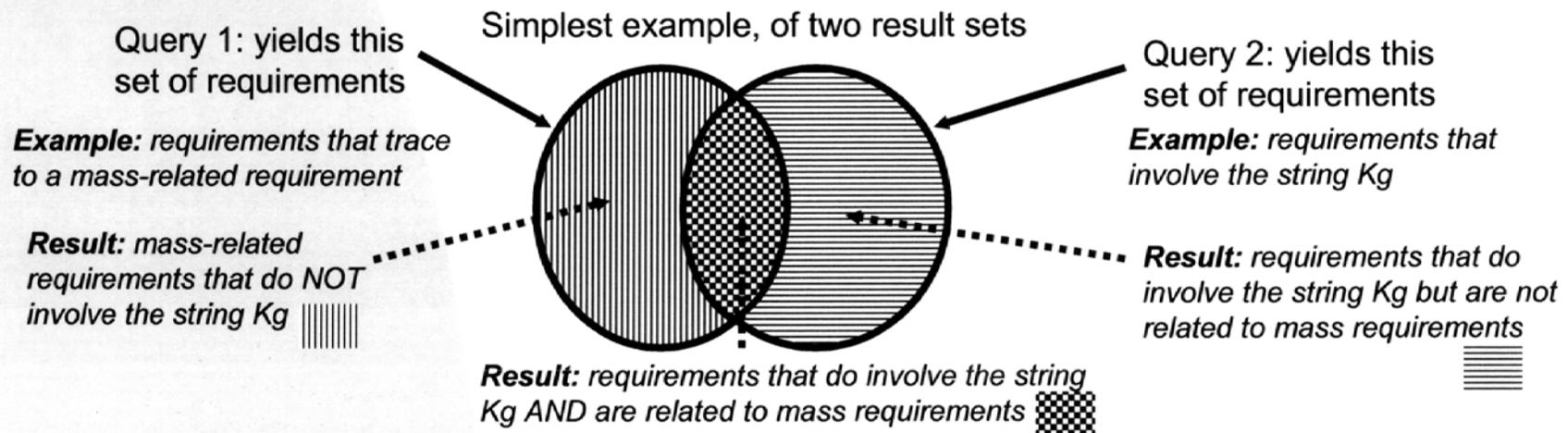
- Examined ST-6 Autonomous Sciencecraft Experiment requirements (approx. 9 pages)
 - ◆ Got a feel for the potential complexity of analyzing the decomposition of resource requirements, while working with a relatively small set of requirements (approximately 9 pages of technical detail)
- Focused on the Mars Reconnaissance Orbiter requirements (approx. 1,370 in all)
 - ◆ Developed a means to use the project-provided traceability information to extract all the requirements that are related to a requirement of interest
 - **WHY:** Convenience & comprehension – extracts just those requirements connected, directly or indirectly, assembling the results into a (web-browser-viewable) table. The result is easier to study than following individual links within the large set of requirements, and is more focused than the “graphic mode” that the requirements tool DOORS provides. In the event of the need to make a change to a requirement, this capability has potential utility, by finding and reporting all the requirements related (directly or indirectly) to that requirement.
 - **HOW:** This is in the form of an automatic script, which takes as input the user’s identification of the requirement of interest, and returns the requirements linked to that (both “parents” of that requirement, and “children” of that requirement), the requirements linked to those requirements, etc.
 - ◆ Developed a means independent of the project traceability information to extract relevant requirements.
 - **WHY:** avoids reliance on the potentially incomplete or incorrect the traceability information within the existing documentation, thus giving a means in independently assure the correctness of requirements decomposition.
 - **HOW:** text-based search for keywords (e.g., search for the word “mass” and the string “kg” – for kilograms), and regular-expression textual searches for more refined patterns (e.g., a digit, then a space, then the letters “kg”)



Requirements Decomposition Analysis

Highlights (cont'd)

- Trace- and string-based means to query a set of requirements have been developed. The result of such a query is a set of requirements. We have also developed capabilities to compare such result sets. Given two or more queries each of which yields a set of requirements, the capabilities developed allow the calculation of the intersection, difference and union among the several returned sets.
- The simplest example, of two results sets, is shown below. The results are placed into one of three categories: occurs in only the results returned by the first query; occurs in only the results returned by the second query; occurs in both sets of results (see diagram below). More generally, for N queries, results are distributed among $2N - 1$ categories.



As before, for easy of viewing the results are presented in HTML tables that provide hyperlinks to the requirements themselves.



Requirements Decomposition Analysis

Highlights (cont'd)

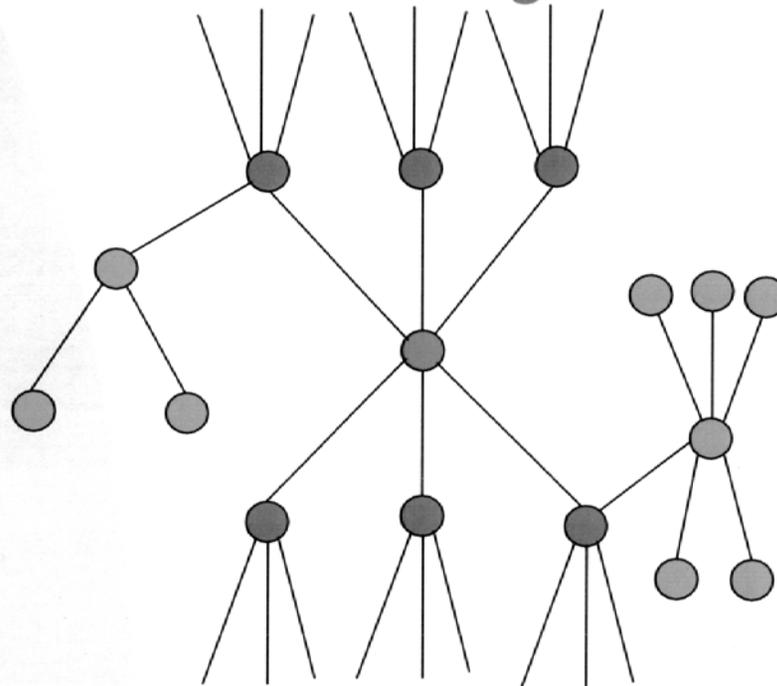
- Tools Developed
 - ◆ TraceRequirements.pl
 - Traces one or more requirements through a set of documents
 - For each specified requirement, parents and children are found, as well as siblings and all other possible relatives
 - ◆ FindPatterns.pl
 - A specified set of documents is searched for one or more patterns
 - Patterns can be specified as regular expressions
 - ◆ CompareResults.pl
 - Two or more trace and/or search results are compared to identify requirements common to the results



Requirements Decomposition Analysis

Tools Overview

- How TraceRequirements.pl differs from parent and child tracing:

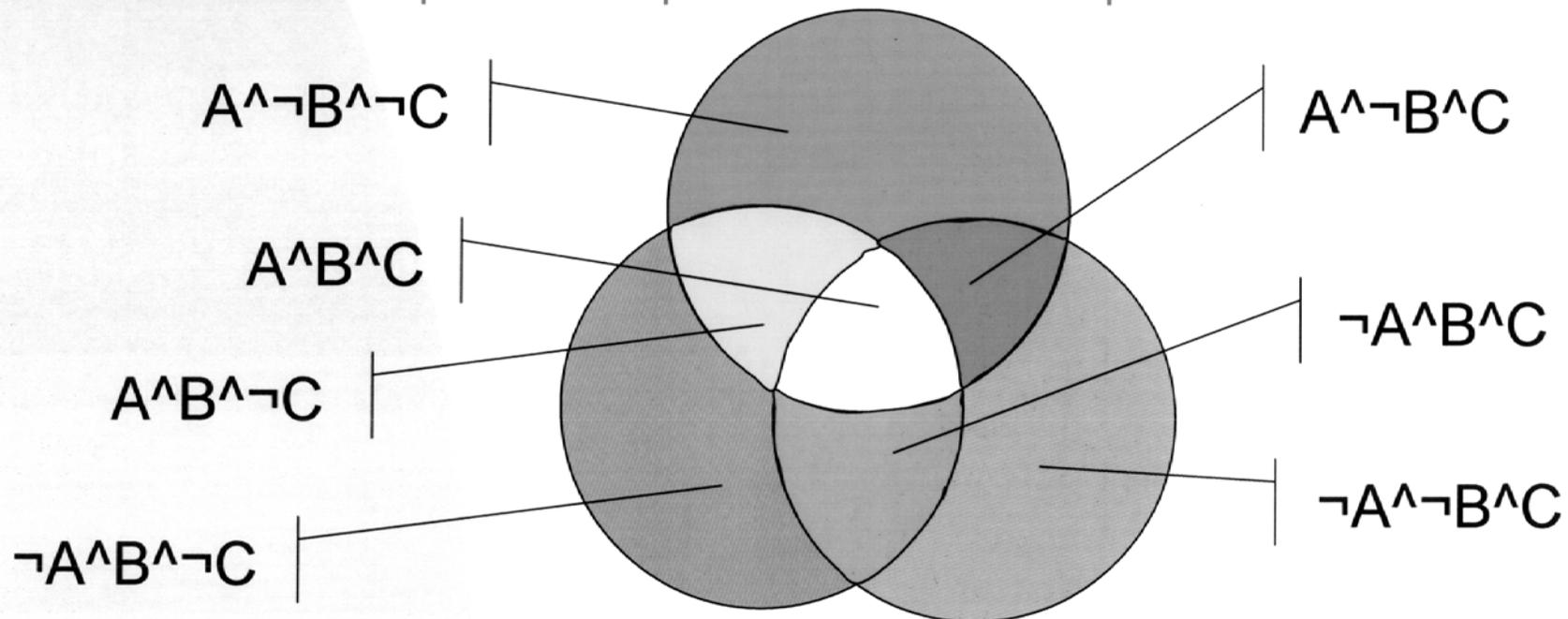




Requirements Decomposition Analysis

Tools Overview (cont'd)

- How CompareResults.pl compares results produced by TraceRequirements.pl and/or FindPatterns.pl
 - Example: A, B, and C are results produced by TraceRequirements.pl and FindPatterns.pl





Requirements Decomposition Analysis

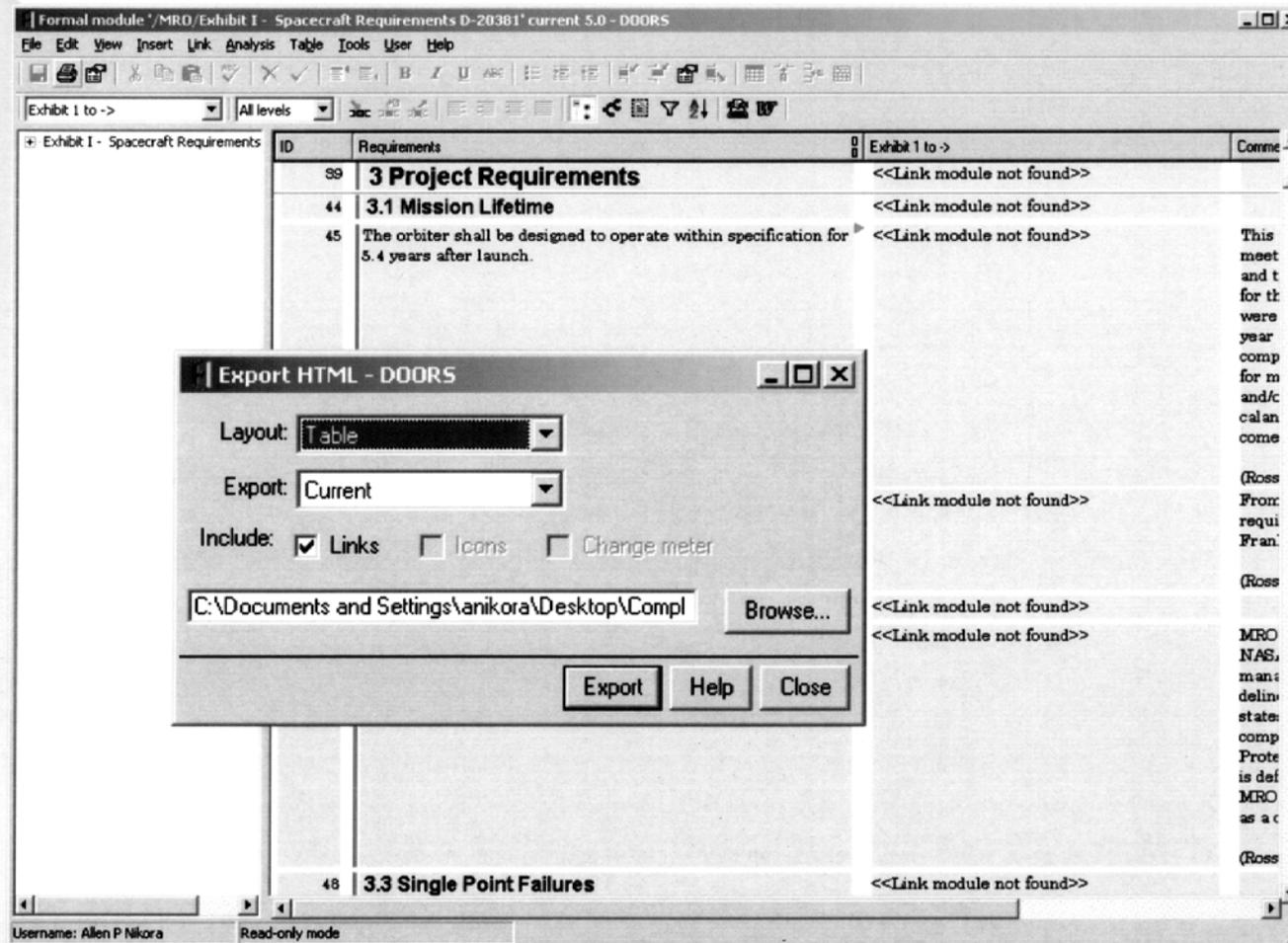
Running the Tools – Preliminaries

- The tools operate on HTML files exported from DOORS documents. Before attempting to use the tools:
 - ◆ Export all of the requirements documents you'll be working on from DOORS to HTML documents.
 - ◆ Make sure that you export them in tabular form and include the links.
- The tools are executed from the DOS command prompt.
- Before running the tools, change to the directory in which the exported DOORS files reside.
 - ◆ These aren't quite production tools yet, and may not work properly if you don't change directories.



Requirements Decomposition Analysis

Running the Tools – Preliminaries (cont'd)



File->
Export->
HTML

Exporting DOORS modules as HTML files



Help Screen – TraceRequirements.pl

```
Command Prompt
C:\>TraceRequirements.pl
This script constructs a requirements lattice by identifying all of the
parents and children of a given requirement, all of their parents and children,
and so on until no more parents and children can be identified.

Usage: TraceRequirements.pl -i <Filename> [options]

where <Filename> is the name of file listing the requirements to be traced.
Each row of <Filename> contains the pair <HTML_FILENAME>, <Requirement ID>.
<HTML_FILENAME> and <Requirement ID> are separated by comma characters.
<HTML_FILENAME> and <Requirement ID> must not contain comma characters.
<HTML_FILENAME> can be a fully-qualified filename, or can refer to a file
in the current directory.

NOTE: This script assumes that all other files to which the requirements in
<HTML_FILENAME> are linked are in the same directory as <HTML_FILENAME>;

<HTML_FILENAME> identifies a DOORS document, containing the requirement
<Requirement ID>, that has been exported to HTML. <Filename> may identify
several requirements from the same document, but may not identify requirements
from different documents. When exporting the DOORS document to HTML, all of
the modules related to each requirement must be exported.

Output is written to an HTML file having the following format:

Column 1 - requirements file name - the name of the html file
containing the requirement being traced.
Column 2 = requirement ID - the numerical ID of the requirement
being traced.
Column 3 - the inbound links to the requirement - each link is
a pair of the form <requirements file name, requirement ID>.
Column 4 - the outbound links from the requirement - the format
is the same as that for inbound links.
Column 5 - requirement type - a requirement can be a root (and there
can be more than one root in a trace lattice), a terminal, or neither.
The originally requested requirement for tracing (identified in
<Filename>), is indicated by the value "Requirement being traced".
Column 6 - the text of the requirement.

Command line options are as follows:

-o <Output File Name> - specifies the name of the output file. The extension
".html" is appended to the end of specified name. An existing
file with the same name will be overwritten.

-q - Selecting this option will suppress printing of the column containing the
text of the requirement - see description of Column 6 above.

C:\>
```



Requirements Decomposition Analysis



Input Files for TraceRequirements.pl

- Input file identified by “-i” command line flag lists the requirements that are to be traced.
- Example input file:

C:\Documents and Settings\anikora\Desktop\Complete MRO Requirements HTML Tables\MRO_Exhibit_I_-_Spacecraft_Requirements_D-20381.htm, 273
C:\Documents and Settings\anikora\Desktop\Complete MRO Requirements HTML Tables\MRO_Exhibit_I_-_Spacecraft_Requirements_D-20381.htm, 274
C:\Documents and Settings\anikora\Desktop\Complete MRO Requirements HTML Tables\MRO_Exhibit_I_-_Spacecraft_Requirements_D-20381.htm, 275
C:\Documents and Settings\anikora\Desktop\Complete MRO Requirements HTML Tables\MRO_Exhibit_I_-_Spacecraft_Requirements_D-20381.htm, 276
C:\Documents and Settings\anikora\Desktop\Complete MRO Requirements HTML Tables\MRO_Exhibit_I_-_Spacecraft_Requirements_D-20381.htm, 277
C:\Documents and Settings\anikora\Desktop\Complete MRO Requirements HTML Tables\MRO_Exhibit_I_-_Spacecraft_Requirements_D-20381.htm, 278
C:\Documents and Settings\anikora\Desktop\Complete MRO Requirements HTML Tables\MRO_Exhibit_I_-_Spacecraft_Requirements_D-20381.htm, 279
C:\Documents and Settings\anikora\Desktop\Complete MRO Requirements HTML Tables\MRO_Exhibit_I_-_Spacecraft_Requirements_D-20381.htm, 877
C:\Documents and Settings\anikora\Desktop\Complete MRO Requirements HTML Tables\MRO_Exhibit_I_-_Spacecraft_Requirements_D-20381.htm, 878
C:\Documents and Settings\anikora\Desktop\Complete MRO Requirements HTML Tables\MRO_Exhibit_I_-_Spacecraft_Requirements_D-20381.htm, 1127



Requirements Decomposition Analysis

Output Files from TraceRequirements.pl



TestPowerTrace - Netscape

File Edit View Go Bookmarks Tools Window Help

file:///C:/Documents%20and%20Settings/ankora/Desktop/Complete%20MRO%20Requirements%20HTML%20Tables/TestPowerTrace.html

Requirements Traced

1. [MRO Exhibit I - Spacecraft Requirements D-20381.htm, 273](#)
(Link to trace results)
2. [MRO Exhibit I - Spacecraft Requirements D-20381.htm, 274](#)
(Link to trace results)
3. [MRO Exhibit I - Spacecraft Requirements D-20381.htm, 275](#)
(Link to trace results)
4. [MRO Exhibit I - Spacecraft Requirements D-20381.htm, 276](#)
(Link to trace results)
5. [MRO Exhibit I - Spacecraft Requirements D-20381.htm, 277](#)
(Link to trace results)
6. [MRO Exhibit I - Spacecraft Requirements D-20381.htm, 278](#)
(Link to trace results)
7. [MRO Exhibit I - Spacecraft Requirements D-20381.htm, 279](#)
(Link to trace results)
8. [MRO Exhibit I - Spacecraft Requirements D-20381.htm, 877](#)
(Link to trace results)
9. [MRO Exhibit I - Spacecraft Requirements D-20381.htm, 878](#)
(Link to trace results)
10. [MRO Exhibit I - Spacecraft Requirements D-20381.htm, 1127](#)
(Link to trace results)

Requirements Trace Results

Trace results for [_MRO_Exhibit_I_-_Spacecraft_Requirements_D-20381.htm](#), requirement 273

Filename	ID	Ancestors	Descendants	Reqn's Type	
_MRO_Exhibit_I_-_Spacecraft_Requirements_D-20381.htm	273		1. _MRO_L2.5_Project_System_Requirements_D-22212.htm , 846	Root, Requirement being traced	After achieving the primary science average payload power of 200W requires 11 W of power for the payload's 200 W allocation. The Electron is operated.
_MRO_L2.5_Project_System_Requirements_D-22212.htm	846	1. _MRO_L3_Payload_System_Requirements_D-22219.htm , 50 2. _MRO_Exhibit_I_-_Spacecraft_Requirements_D-20381.htm , 273		Terminal	The FS shall be designed and operated orbital average power consumption
_MRO_L3_Payload_System_Requirements_D-22219.htm	50		1. _MRO_L2.5_Project_System_Requirements_D-22212.htm , 846	Root	After the spacecraft achieves the power consumption including a

[Return to the top of the page.](#)

Trace results for [_MRO_Exhibit_I_-_Spacecraft_Requirements_D-20381.htm](#), requirement 274

Filename	ID	Ancestors	Descendants	Reqn's Type	
_MRO_Exhibit_I_-_Spacecraft_Requirements_D-20381.htm	274		1. _MRO_Related_Projects_M01_Exhibit_I_Observer_Reqn.htm , 262 2. _MRO_L2.5_Project_System_Requirements_D-22212.htm , 1286 3. _MRO_L2.5_Project_System_Requirements_D-22212.htm , 847	Root, Requirement being traced	While in cruise to Mars, the margins for the payload electronics signal to the spacecraft shall
_MRO_Related_Projects_M01_Exhibit_I_Observer_Reqn.htm	262	1. _MRO_Exhibit_I_-_Spacecraft_Requirements_D-20381.htm , 274		Terminal	The orbiter shall provide a MOI and aerobraking, 32.5 mapping phase, and 64.0 V the science orbit.
_MRO_L2.5_Project_System_Requirements_D-22212.htm	1286	1. _MRO_Exhibit_I_-_Spacecraft_Requirements_D-20381.htm , 274		Terminal	During the Cruise and Apg consistent with a Payload energy provided per orbit.
_MRO_L2.5_Project_System_Requirements_D-22212.htm	847	1. _MRO_L3_Payload_System_Requirements_D-22219.htm , 81 2. _MRO_Exhibit_I_-_Spacecraft_Requirements_D-20381.htm , 274		Terminal	During the Cruise and Apg consistent with a continuous reserves]
_MRO_L3_Payload_System_Requirements_D-22219.htm	81	1. _MRO_L4_ONC_Functional_Requirements_Document_D-22221.htm , 137	1. _MRO_L2.5_Project_System_Requirements_D-22212.htm , 1549 2. _MRO_L2.5_Project_System_Requirements_D-22212.htm , 847		Payload total cruise and Mars: Launch = 30 W Descontamination = 215 W

Document: Done (23.679 sec)

Command line: TraceRequirements.pl -i PowerRequirementsFile.txt -o TestPowerTrace.html
 8 June, 2004 NASA Assurance Technology Symposium 13



Help Screen – FindPatterns.pl

```
Command Prompt
C:\>FindPatterns.pl
This script finds occurrences of specified patterns in html documents
exported from DOORS and writes the search results to an html file that
contains the text of each requirement matching any of the specified
patterns.

Usage: FindPatterns.pl -d <Document List> -p <Search Patterns> [options]

where <Document List> is a list of command line arguments identifying the
html documents that are to be searched for patterns specified by the user.
Each argument in <Document List> contains the fully qualified name of an
HTML file exported from DOORS in table format. <Search Patterns> is one
or more regular expressions, separated by white space, for which a search
will be made in the text of the documents identified by <Document List>.

Example: FindPattern.pl -p \d -d SampleText -d Requirements_1.html Req_Doc_2.htm
will search for digits and the text "Sample Text" in the documents
"Requirements_1.html" and "Req_Doc_2.htm".

Output is written as HTML having the following format:

Column 1 - requirements file name - the name of the html file
matching one or more of the search patterns.
Column 2 - requirement ID - the numerical ID of the requirement
containing one or more of the patterns.
Column 3 - the inbound links to the requirement - each link is
a pair of the form <requirements file name, requirement ID>.
Column 4 - the outbound links from the requirement - the format
is the same as that for inbound links.
Column 5 - Identifies the pattern(s) matched in the requirements
text, and how many times each pattern was matched.
Column 6 - the text of the requirement containing one or more
of the search patterns.

Unless the name of an output file is specified, the output is written
to the standard output, STDOUT.

Command line options are as follows:
-df <Document Name File> - specifies the name of a text file
containing a list of the html documents that will be searched for
patterns. Users have the option of specifying document file names
inline with the -d option instead of or in addition to this option.
this option. However, if no document names are specified, the user will
be prompted to either specify the names in-line or specify the name of a
text file containing the documents to be searched.

-pf <Search Pattern File> - specifies the name of a text file
containing a list of patterns for which the specified documents will be
searched. Users have the option of specifying patterns inline with the
-p option instead of or in addition to this option. However, if no
patterns are specified, the user will be prompted to either specify the
patterns in-line or provide the name of a text file containing the
patterns for which to search the documents.

-o <Output File Name> - specifies the name of the output file. The extension
".html" is appended to the end of specified name. An existing file with
the same name will be overwritten with no warning.

-q - Selecting this option will suppress printing of the column containing the
text of the requirement - see description of Column 6 above.

C:\>_
```



Requirements Decomposition Analysis



Input Files to FindPatterns.pl

- Input file identified by “-df” command line flag lists the documents that are to be searched for patterns. An example is shown below:

```
C:\Documents and Settings\anikora\Desktop\Complete MRO Requirements HTML Tables\MRO_Exhibit_I_-_Spacecraft_Requirements_D-20381.htm
C:\Documents and Settings\anikora\Desktop\Complete MRO Requirements HTML Tables\MRO_DAV_V_Design_Principles___Rev_1_copy_to_MRO_02-26-02.htm
C:\Documents and Settings\anikora\Desktop\Complete MRO Requirements HTML Tables\MRO_Exhibit_IV_-_Mission_Ops_Rqmts_D-20519.htm
C:\Documents and Settings\anikora\Desktop\Complete MRO Requirements HTML Tables\MRO_L1_Level_1_Requirements_-_Appendix_to_Program_Plan_D-22204.htm
C:\Documents and Settings\anikora\Desktop\Complete MRO Requirements HTML Tables\MRO_L2.5_Project_System_Requirements_D-22212.htm
C:\Documents and Settings\anikora\Desktop\Complete MRO Requirements HTML Tables\MRO_L2_Mission_Assurance_Requirements_D-20327.htm
...
```

- Input file identified by “-pf” command line flag identifies the patterns for which the documents are to be searched. An example is shown below:

```
(\s)+[t|T]ime
(\s)+[s|S]oon
(\s)+[l|L]ate
(\s)+[e|E]arly
(\s)+[e|E]arlie
(\s)+[b|B]efore
(\s)+[a|A]fter
(\s)+[s|S]econd
(\d)+(\s)*[m|M][s|S]
(\s)+[m|M]icrose
(\s)+[h|H]our
(\s)+[m|M]inute
(\s)+[d|D]ay
(\s)+[m|M]onth
(\s)+[y|Y]ear
```



Requirements Decomposition Analysis

Output Files from FindPatterns.pl



Documents Searched

- MRO Exhibit I - Spacecraft Requirements D-20381.htm (Link to search results)
- MRO DAY V Design Principles - Rev 1 copy to MRO 02-26-02.htm (Link to search results)
- MRO Exhibit IV - Mission Org Equate D-20519.htm (Link to search results)
- MRO L1 Level 1 Requirements - Appendix to Program Plan D-22204.htm (Link to search results)
- MRO L2.5 Project System Requirements D-22212.htm (Link to search results)
- MRO L2 Mission Assurance Requirements D-20327.htm (Link to search results)
- MRO L2 Project Policies D-22237.htm (Link to search results)
- MRO L2 Project Requirements D-20454.htm (Link to search results)
- MRO L2 Science Requirements D-22211.htm

Search Patterns

- Kg
- kg

Pattern Search Results

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C:\Documents and Settings\ankora\Desktop\Complete MRO Requirements HTML Tables\MRO_L2.5_Project_System_Requirements_D-22212.htm

Filename	ID	Ancestors	Descendants	Matched Patterns, Number of Matches	Requirement Text
MRO L2.5 Project System Requirements D-22212.htm	284	1. MRO Exhibit I - Spacecraft Requirements D-20381.htm, 132 2. MRO L3 Launch Vehicle Technical Requirements D-20069.htm, 43		kg, 1	The PS shall be designed for a mass
MRO L2.5 Project System Requirements D-22212.htm	1317	1. MRO Exhibit I - Spacecraft Requirements D-20381.htm, 213		kg, 1	The minimum size of an orbiter background sequence (bits to TBS
MRO L2.5 Project System Requirements D-22212.htm	845	1. MRO L3 Payload System Requirements D-22219.htm, 43 2. MRO Exhibit I - Spacecraft Requirements D-20381.htm, 129		kg, 1	The PS shall be designed to accomm
MRO L2.5 Project System Requirements D-22212.htm	1609	1. MRO Exhibit I - Spacecraft Requirements D-20381.htm, 132		kg, 1	The PS shall accommodate a rese
MRO L2.5 Project System Requirements D-22212.htm	1325	1. MRO Exhibit I - Spacecraft Requirements D-20381.htm, 47	1. MRO L2 Science Requirements D-22211.htm, 1050 2. MRO L2 Science Requirements D-22211.htm, 1111	kg, 1	The PS shall create and maintain a constituents of the orbiter.
MRO L2.5 Project System Requirements D-22212.htm	1674			kg, 1	Project Mass Summary (kg) PL Allocation 139 SIC Dry Allocation 839 PM Reserve 35.5 Propellant Allocation 1149 Electra Allocation 17.5 Total 2180

Return to the top of the page

C:\Documents and Settings\ankora\Desktop\Complete MRO Requirements HTML Tables\MRO_L2_Mission_Assurance_Requirements_D-20327.htm

Filename	ID	Ancestors	Descendants	Matched Patterns, Number of Matches	Requirement Text
No patterns matched in this document.					

Command line: FindPatterns.pl -df DocumentNames_3.txt -p Kg kg -o KilogramSearchFrame.html

8 June, 2004

NASA Assurance Technology Symposium

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Help Screen – CompareResults.pl

```
Command Prompt
C:\>CompareResults.pl

This script compares two or more files obtained with either of the scripts
"TraceReqs.pl" or "FindPatterns.pl". The output is an html file identifying
the requirements common to each of the possible subsets of the specified result
files. For example, if 3 result files were specified, there would be 7
combinations of result files that would be analyzed (2**3-1). See the help
screens for "TraceReqs.pl" and "FindPatterns.pl" for detailed information on
their use.

Usage:

CompareResults.pl -i <ResultFile 1> <ResultFile 2> [<ResultFile 3> ...]
[-c|-e|-u] [-if <ResultFileNamesFile>] [-o <OutputFileName>] [-v]

where:

<ResultFile X> is the name of an html file produced with the script
"FindPatterns.pl" or "TraceReqs.pl".

<ResultFileNamesFile> is an optional file containing the names of result
files. The -if option can be used instead of or in addition to the -i option
to avoid entering a large number of result file names on the command line.

There are three choices for specifying how the results are to be compared:

-c: In each subset, look for a result, but do not check to make sure that
the result is not contained in results files that are not part of the
subset. For example, if there are four results files A, B, C, and D,
and a search is being done to find results common to B and C, this
option will not check for the nonexistence of the results in A and D.
THIS IS THE DEFAULT CHOICE FOR COMPARING RESULTS.

-e: In each subset, look for a result, and check to make sure that
the result is not contained in results files that are not part of the
subset. For example, if there are four results files A, B, C, and D,
and a search is being done to find results common to B and C, this
option will check for the nonexistence of the results in A and D.

-u: Do not compare results, but report the union of all the result files.

<OutputFileName> is an optional name for an html file that will contain the
result of running this script. The extension ".html" is added to the name of
the file. If no filename is supplied, the results are written to the
standard output.

-v denotes the verbose option. If this option is selected, progress messages
will be printed on the standard output if the -o option has also been
selected. If this option has not been selected, or if the -o option has not
been selected, no progress messages will be displayed.

C:\>
```



Requirements Decomposition Analysis

Input Files to CompareResults.pl

- Input file identified by “-if” command line flag identifies the results that are to be compared. An example is shown below:

TestMassTrace.html

KilogramSearchFrame.html

MassSearchFrame.html

- TestMassTrace is the output of the “TraceRequirements.pl” script for a set of requirements related to mass.
- KilogramSearchFrame.html is the output of the “FindPatterns.pl” script when searching all documents for either “Kg” or “kg”.
- MassSearchFrame.html is the output of the “FindPatterns.pl” script when searching all documents for either “Mass” or “mass”.



Requirements Decomposition Analysis



Output Files from CompareResults.pl

TestOutput13 - Netscape

file:///C:/Documents%20and%20Settings/ankora/Desktop/Complete%20MRO%20Requirements%20HTML%20Tables/TestOutput13.html

Results Files Compared

1. TestMassTrace.html
2. KilogramSearchFrame.html
3. MassSearchFrame.html

Subset Comparison Results

Subset 111

Contained In:

1. TestMassTrace.html
2. KilogramSearchFrame.html
3. MassSearchFrame.html

Not Contained In:

Filename	ID	Ancestors	Descendants	Requirement Text
MRO Exhibit 1 - Spacecraft Requirements D-20381.htm	159		<ol style="list-style-type: none"> 1. MRO Related Projects M01 Exhibit 1 Orbiter Req.htm, 22 2. MRO L2.5 Project System Requirements D-22212.htm, 845 3. MRO L2.5 Project System Requirements D-22212.htm, 1609 4. MRO L2.5 Project System Requirements D-22212.htm, 284 	The spacecraft shall be designed for a maximum of the following allocations: Spacecraft Wet Mass - 1988.0 Kg Instruments - 139.0 Kg Electra - 17.5 Kg Project Manager Reserve - 35.5 Kg
MRO L2.5 Project System Requirements D-22212.htm	284	<ol style="list-style-type: none"> 1. MRO Exhibit 1 - Spacecraft Requirements D-20381.htm, 159 2. MRO L3 Launch Vehicle Technical Requirements D-number.htm, 43 		The FS shall be designed for a maximum injected
MRO L2.5 Project System Requirements D-22212.htm	845	<ol style="list-style-type: none"> 1. MRO L3 Payload System Requirements D-22219.htm, 45 2. MRO Exhibit 1 - Spacecraft Requirements D-20381.htm, 159 		The FS shall be designed to accommodate 156.5 M
MRO L3 Payload System Requirements D-22219.htm	45		<ol style="list-style-type: none"> 1. MRO L2.5 Project System Requirements D-22212.htm, 845 	The payload system mass shall not exceed 139 kg
MRO Related Projects M01 Exhibit 1 Orbiter Req.htm	22	<ol style="list-style-type: none"> 1. MRO Exhibit 1 - Spacecraft Requirements D-20381.htm, 159 		The maximum orbiter launch mass shall be 758 kg commanded shutdown).

Return to the top of the page.

Subset 011

Contained In:

1. KilogramSearchFrame.html
2. MassSearchFrame.html

Not Contained In:

1. TestMassTrace.html

Filename	ID	Ancestors	Descendants	Requirement Text
MRO DAV V Design Principles Rev 1 copy to MRO 02-26-02.htm	160			Because of the ambitious nature (technical and programmatic) of management is necessary to enable success. Therefore, it is prudent resources to account for and accommodate uncertainties and expend power resources in conjunction with ample funding resources, developmental and operational issues, and enable timely, balanced having to perform time-consuming trade studies to micro-manage projects can use. Timeline to estimate mass and/or power needs.

1. 111
2. 011
3. 101
4. 110
5. 001
6. 010
7. 100

file:///C:/Documents and Settings/ankora/Desktop/Complete MRO Requirements HTML Tables/MRO_L2.5_Project_System_Requirements_D-22212.htm#294

Command line: CompareResults.pl -if ResultFileNames4.txt -o TestOutput13 -e



Requirements Decomposition Analysis

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Requirements Decomposition Analysis

Task Description

- **Problem Statement:** Requirements play a pivotal role in planning, selection, development, testing and operation of NASA's missions. Starting from mission objectives, requirements are successively decomposed. The correctness of this decomposition is critical, yet V&V of this crucial step is limited to manual inspection and pointwise testing, which are cumbersome and fallible (e.g., Mars Polar Lander).
- **Task:** Rigorous lightweight analysis methods for requirements decomposition have been developed by the software engineering research community, and have shown promise in successful application to critical systems (e.g., rail transportation). This proposal will study their application to the V&V of spacecraft software requirements, to ascertain if, when and how they are suitable for use by NASA.



Requirements Decomposition Analysis

Goals and Objectives

- **Goal:** study the applicability to NASA spacecraft requirements of rigorous analysis methods for requirements decomposition that have been developed by the software engineering research community.
- **Objectives:**
 1. **M**anually apply decomposition analysis methods applied to spacecraft requirements.
 2. Based on the results of of these application studies, emerge with recommendations for the application of these methods, identify needed extensions to those methods, and indicate the opportunities for their support (e.g., via checklists, procedures and/or tool support).
 3. Develop the most promising support approaches identified by the first phase to make them suitable for application to NASA's spacecraft requirements.



Requirements Decomposition Analysis

Highlights

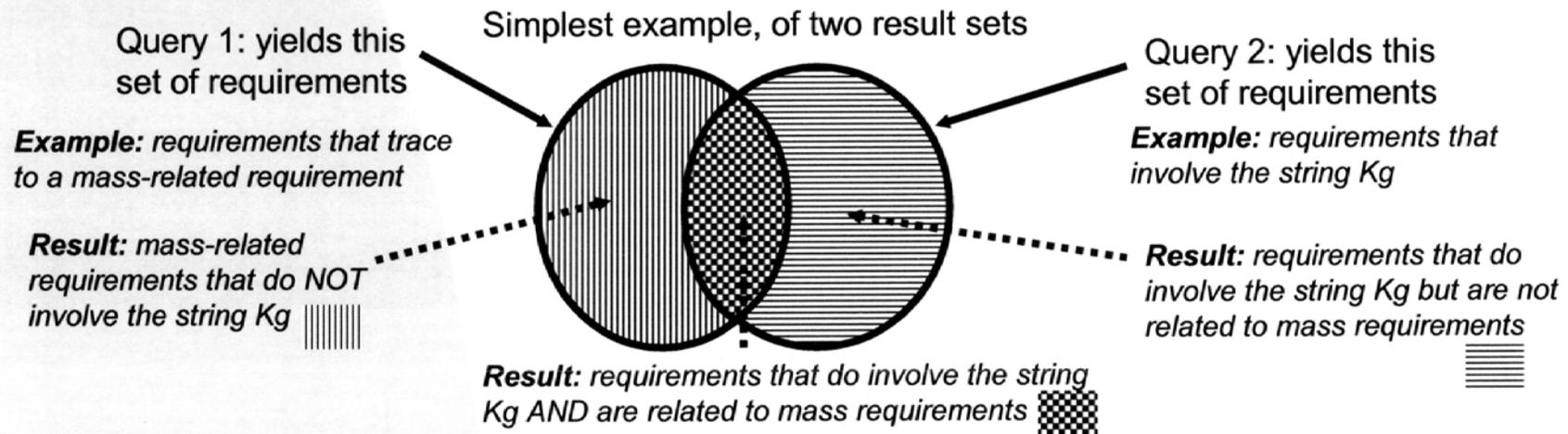
- Examined ST-6 Autonomous Sciencecraft Experiment requirements (approx. 9 pages)
 - ◆ Got a feel for the potential complexity of analyzing the decomposition of resource requirements, while working with a relatively small set of requirements (approximately 9 pages of technical detail)
- Focused on the Mars Reconnaissance Orbiter requirements (approx. 1,370 in all)
 - ◆ Developed a means to use the project-provided traceability information to extract all the requirements that are related to a requirement of interest
 - **WHY:** Convenience & comprehension – extracts just those requirements connected, directly or indirectly, assembling the results into a (web-browser-viewable) table. The result is easier to study than following individual links within the large set of requirements, and is more focused than the “graphic mode” that the requirements tool DOORS provides. In the event of the need to make a change to a requirement, this capability has potential utility, by finding and reporting all the requirements related (directly or indirectly) to that requirement.
 - **HOW:** This is in the form of an automatic script, which takes as input the user’s identification of the requirement of interest, and returns the requirements linked to that (both “parents” of that requirement, and “children” of that requirement), the requirements linked to those requirements, etc.
 - ◆ Developed a means independent of the project traceability information to extract relevant requirements.
 - **WHY:** avoids reliance on the potentially incomplete or incorrect the traceability information within the existing documentation, thus giving a means in independently assure the correctness of requirements decomposition.
 - **HOW:** text-based search for keywords (e.g., search for the word “mass” and the string “kg” – for kilograms), and regular-expression textual searches for more refined patterns (e.g., a digit, then a space, then the letters “kg”)



Requirements Decomposition Analysis

Highlights (cont'd)

- Trace- and string-based means to query a set of requirements have been developed. The result of such a query is a set of requirements. We have also developed capabilities to compare such result sets. Given two or more queries each of which yields a set of requirements, the capabilities developed allow the calculation of the intersection, difference and union among the several returned sets.
- The simplest example, of two results sets, is shown below. The results are placed into one of three categories: occurs in only the results returned by the first query; occurs in only the results returned by the second query; occurs in both sets of results (see diagram below). More generally, for N queries, results are distributed among $2N - 1$ categories.



As before, for easy of viewing the results are presented in HTML tables that provide hyperlinks to the requirements themselves.



Requirements Decomposition Analysis

Highlights (cont'd)

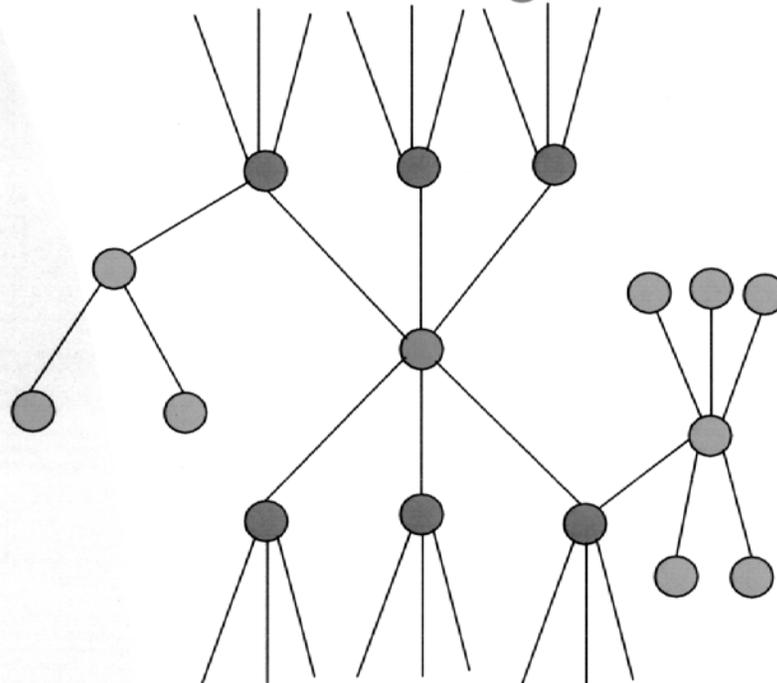
- Tools Developed
 - ◆ TraceRequirements.pl
 - Traces one or more requirements through a set of documents
 - For each specified requirement, parents and children are found, as well as siblings and all other possible relatives
 - ◆ FindPatterns.pl
 - A specified set of documents is searched for one or more patterns
 - Patterns can be specified as regular expressions
 - ◆ CompareResults.pl
 - Two or more trace and/or search results are compared to identify requirements common to the results



Requirements Decomposition Analysis

Tools Overview

- How TraceRequirements.pl differs from parent and child tracing:

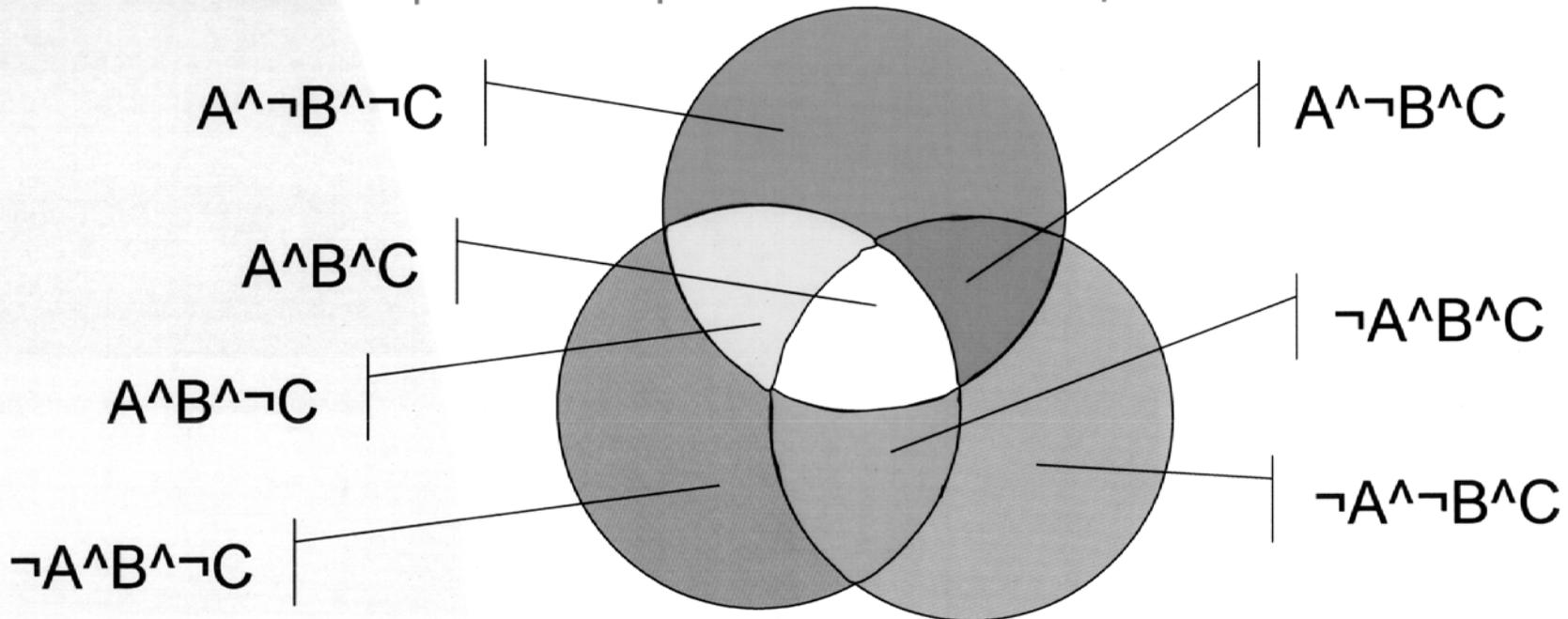




Requirements Decomposition Analysis

Tools Overview (cont'd)

- How CompareResults.pl compares results produced by TraceRequirements.pl and/or FindPatterns.pl
 - Example: A, B, and C are results produced by TraceRequirements.pl and FindPatterns.pl





Requirements Decomposition Analysis

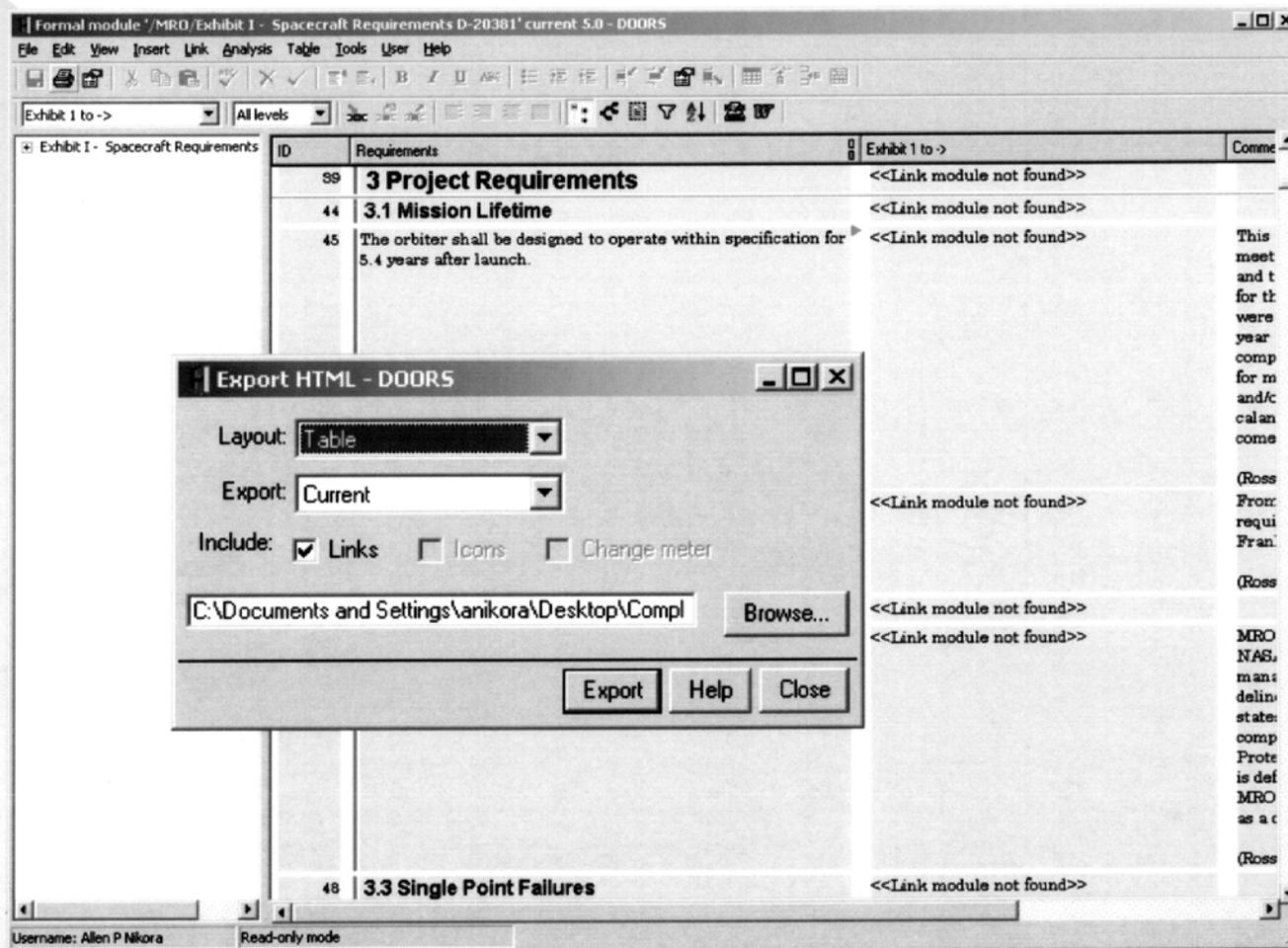
Running the Tools – Preliminaries

- The tools operate on HTML files exported from DOORS documents. Before attempting to use the tools:
 - ◆ Export all of the requirements documents you'll be working on from DOORS to HTML documents.
 - ◆ Make sure that you export them in tabular form and include the links.
- The tools are executed from the DOS command prompt.
- Before running the tools, change to the directory in which the exported DOORS files reside.
 - ◆ These aren't quite production tools yet, and may not work properly if you don't change directories.



Requirements Decomposition Analysis

Running the Tools – Preliminaries (cont'd)



File->
Export->
HTML

Exporting DOORS modules as HTML files



Help Screen – TraceRequirements.pl

```
Command Prompt
C:\>TraceRequirements.pl
This script constructs a requirements lattice by identifying all of the
parents and children of a given requirement, all of their parents and children,
and so on until no more parents and children can be identified.

Usage: TraceRequirements.pl -i <Filename> [options]

where <Filename> is the name of file listing the requirements to be traced.
Each row of <Filename> contains the pair <HTML_FILENAME>, <Requirement ID>.
<HTML_FILENAME> and <Requirement ID> are separated by comma characters.
<HTML_FILENAME> and <Requirement ID> must not contain comma characters.
<HTML_FILENAME> can be a fully-qualified filename, or can refer to a file
in the current directory.

NOTE: This script assumes that all other files to which the requirements in
<HTML_FILENAME> are linked are in the same directory as <HTML_FILENAME>;

<HTML_FILENAME> identifies a DOORS document, containing the requirement
<Requirement ID>, that has been exported to HTML. <Filename> may identify
several requirements from the same document, but may not identify requirements
from different documents. When exporting the DOORS document to HTML, all of
the modules related to each requirement must be exported.

Output is written to an HTML file having the following format:

Column 1 - requirements file name - the name of the html file
containing the requirement being traced.
Column 2 = requirement ID - the numerical ID of the requirement
being traced.
Column 3 - the inbound links to the requirement - each link is
a pair of the form <requirements file name, requirement ID>.
Column 4 - the outbound links from the requirement - the format
is the same as that for inbound links.
Column 5 - requirement type - a requirement can be a root (and there
can be more than one root in a trace lattice), a terminal, or neither.
The originally requested requirement for tracing (identified in
<Filename>), is indicated by the value "Requirement being traced".
Column 6 - the text of the requirement.

Command line options are as follows:

-o <Output File Name> - specifies the name of the output file. The extension
".html" is appended to the end of specified name. An existing
file with the same name will be overwritten.

-q - Selecting this option will suppress printing of the column containing the
text of the requirement - see description of Column 6 above.

C:\>
```



Requirements Decomposition Analysis

Input Files for TraceRequirements.pl

- Input file identified by “-i” command line flag lists the requirements that are to be traced.
- Example input file:

C:\Documents and Settings\anikora\Desktop\Complete MRO Requirements HTML Tables\MRO_Exhibit_I_-_Spacecraft_Requirements_D-20381.htm, 273
C:\Documents and Settings\anikora\Desktop\Complete MRO Requirements HTML Tables\MRO_Exhibit_I_-_Spacecraft_Requirements_D-20381.htm, 274
C:\Documents and Settings\anikora\Desktop\Complete MRO Requirements HTML Tables\MRO_Exhibit_I_-_Spacecraft_Requirements_D-20381.htm, 275
C:\Documents and Settings\anikora\Desktop\Complete MRO Requirements HTML Tables\MRO_Exhibit_I_-_Spacecraft_Requirements_D-20381.htm, 276
C:\Documents and Settings\anikora\Desktop\Complete MRO Requirements HTML Tables\MRO_Exhibit_I_-_Spacecraft_Requirements_D-20381.htm, 277
C:\Documents and Settings\anikora\Desktop\Complete MRO Requirements HTML Tables\MRO_Exhibit_I_-_Spacecraft_Requirements_D-20381.htm, 278
C:\Documents and Settings\anikora\Desktop\Complete MRO Requirements HTML Tables\MRO_Exhibit_I_-_Spacecraft_Requirements_D-20381.htm, 279
C:\Documents and Settings\anikora\Desktop\Complete MRO Requirements HTML Tables\MRO_Exhibit_I_-_Spacecraft_Requirements_D-20381.htm, 877
C:\Documents and Settings\anikora\Desktop\Complete MRO Requirements HTML Tables\MRO_Exhibit_I_-_Spacecraft_Requirements_D-20381.htm, 878
C:\Documents and Settings\anikora\Desktop\Complete MRO Requirements HTML Tables\MRO_Exhibit_I_-_Spacecraft_Requirements_D-20381.htm, 1127



Requirements Decomposition Analysis

Output Files from TraceRequirements.pl



TestPowerTrace - Netscape

File Edit View Go Bookmarks Tools Window Help

file:///C:/Documents%20and%20Settings/anikora/Desktop/Complete%20MRO%20Requirements%20HTML%20Tables/TestPowerTrace.html

Requirements Traced

- MRO Exhibit I - Spacecraft Requirements D-20381.htm, 273 (Link to trace results)
- MRO Exhibit I - Spacecraft Requirements D-20381.htm, 274 (Link to trace results)
- MRO Exhibit I - Spacecraft Requirements D-20381.htm, 275 (Link to trace results)
- MRO Exhibit I - Spacecraft Requirements D-20381.htm, 276 (Link to trace results)
- MRO Exhibit I - Spacecraft Requirements D-20381.htm, 277 (Link to trace results)
- MRO Exhibit I - Spacecraft Requirements D-20381.htm, 278 (Link to trace results)
- MRO Exhibit I - Spacecraft Requirements D-20381.htm, 279 (Link to trace results)
- MRO Exhibit I - Spacecraft Requirements D-20381.htm, 377 (Link to trace results)
- MRO Exhibit I - Spacecraft Requirements D-20381.htm, 378 (Link to trace results)
- MRO Exhibit I - Spacecraft Requirements D-20381.htm, 1127 (Link to trace results)

Requirements Trace Results

Trace results for MRO Exhibit I - Spacecraft Requirements D-20381.htm, requirement 273

Filename	ID	Ancestors	Descendants	Reqn's Type	
<u>MRO Exhibit I - Spacecraft Requirements D-20381.htm</u>	273		1. <u>MRO L2.5 Project System Requirements D-22212.htm</u> , 846	Root, Requirement being traced	After achieving the primary science average payload power of 200W, require 11 W of power for payload's 200 W allocation if the Electron is operated.
<u>MRO L2.5 Project System Requirements D-22212.htm</u>	846	1. <u>MRO L3 Payload System Requirements D-22219.htm</u> , 50 2. <u>MRO Exhibit I - Spacecraft Requirements D-20381.htm</u> , 273		Terminal	The PS shall be designed and optimized for orbital average power consumption.
<u>MRO L3 Payload System Requirements D-22219.htm</u>	50		1. <u>MRO L2.5 Project System Requirements D-22212.htm</u> , 846	Root	After the spacecraft achieves the power consumption including all

[Return to the top of the page.](#)

Trace results for MRO Exhibit I - Spacecraft Requirements D-20381.htm, requirement 274

Filename	ID	Ancestors	Descendants	Reqn's Type	
<u>MRO Exhibit I - Spacecraft Requirements D-20381.htm</u>	274		1. <u>MRO Related Projects M01 Exhibit I Orbiter Resp.htm</u> , 262 2. <u>MRO L2.5 Project System Requirements D-22212.htm</u> , 1286 3. <u>MRO L2.5 Project System Requirements D-22212.htm</u> , 847	Root, Requirement being traced	While in cruise to Mars, the margins for the payload electric signal to the spacecraft shall
<u>MRO Related Projects M01 Exhibit I Orbiter Resp.htm</u>	262	1. <u>MRO Exhibit I - Spacecraft Requirements D-20381.htm</u> , 274		Terminal	The orbiter shall provide a MCI and aerobraking, 32.5 mapping phase, and 64.0 V the science orbit.
<u>MRO L2.5 Project System Requirements D-22212.htm</u>	1286	1. <u>MRO Exhibit I - Spacecraft Requirements D-20381.htm</u> , 274		Terminal	During the Cruise and Approach consistent with a Payload energy provided per orbit
<u>MRO L2.5 Project System Requirements D-22212.htm</u>	847	1. <u>MRO L3 Payload System Requirements D-22219.htm</u> , 51 2. <u>MRO Exhibit I - Spacecraft Requirements D-20381.htm</u> , 274		Terminal	During the Cruise and Approach consistent with a continuous reserves).
<u>MRO L3 Payload System Requirements D-22219.htm</u>	51	1. <u>MRO L4 OMC Functional Requirements Document D-22221.htm</u> , 137	1. <u>MRO L2.5 Project System Requirements D-22212.htm</u> , 1540 2. <u>MRO L2.5 Project System Requirements D-22212.htm</u> , 847		Payload total cruise and Mars Latched = 80 W Decommissioning = 21.5 W

Document Done (23.679 sec)

Command line: TraceRequirements.pl -i PowerRequirementsFile.txt -o TestPowerTrace.html
8 June, 2004 NASA Assurance Technology Symposium 13



Help Screen – FindPatterns.pl

```
Command Prompt
C:\>FindPatterns.pl
This script finds occurrences of specified patterns in html documents
exported from DOORS and writes the search results to an html file that
contains the text of each requirement matching any of the specified
patterns.

Usage: FindPatterns.pl -d <Document List> -p <Search Patterns> [options]

where <Document List> is a list of command line arguments identifying the
html documents that are to be searched for patterns specified by the user.
Each argument in <Document List> contains the fully qualified name of an
HTML file exported from DOORS in table format. <Search Patterns> is one
or more regular expressions, separated by white space, for which a search
will be made in the text of the documents identified by <Document List>.

Example: FindPattern.pl -p \d SampleText -d Requirements_1.html Req_Doc_2.htm
will search for digits and the text "Sample Text" in the documents
"Requirements_1.html" and "Req_Doc_2.htm".

Output is written as HTML having the following format:

Column 1 - requirements file name - the name of the html file
matching one or more of the search patterns.
Column 2 - requirement ID - the numerical ID of the requirement
containing one or more of the patterns.
Column 3 - the inbound links to the requirement - each link is
a pair of the form <requirements file name, requirement ID>.
Column 4 - the outbound links from the requirement - the format
is the same as that for inbound links.
Column 5 - Identifies the pattern(s) matched in the requirements
text, and how many times each pattern was matched.
Column 6 - the text of the requirement containing one or more
of the search patterns.

Unless the name of an output file is specified, the output is written
to the standard output, STDOUT.

Command line options are as follows:
-df <Document Name File> - specifies the name of a text file
containing a list of the html documents that will be searched for
for patterns. Users have the option of specifying document file names
inline with the -d option instead of or in addition to this option.
this option. However, if no document names are specified, the user will
be prompted to either specify the names in-line or specify the name of a
text file containing the documents to be searched.

-pf <Search Pattern File> - specifies the name of a text file
containing a list of patterns for which the specified documents will be
searched. Users have the option of specifying patterns inline with the
-p option instead of or in addition to this option. However, if no
patterns are specified, the user will be prompted to either specify the
patterns in-line or provide the name of a text file containing the
patterns for which to search the documents.

-o <Output File Name> - specifies the name of the output file. The extension
".html" is appended to the end of specified name. An existing file with
the same name will be overwritten with no warning.

-q - Selecting this option will suppress printing of the column containing the
text of the requirement - see description of Column 6 above.

C:\>_
```



Requirements Decomposition Analysis



Input Files to FindPatterns.pl

- Input file identified by “-df” command line flag lists the documents that are to be searched for patterns. An example is shown below:

```
C:\Documents and Settings\anikora\Desktop\Complete MRO Requirements HTML Tables\MRO_Exhibit_I_-_Spacecraft_Requirements_D-20381.htm
C:\Documents and Settings\anikora\Desktop\Complete MRO Requirements HTML Tables\MRO_DAV_V_Design_Principles___Rev_1_copy_to_MRO_02-26-02.htm
C:\Documents and Settings\anikora\Desktop\Complete MRO Requirements HTML Tables\MRO_Exhibit_IV_-_Mission_Ops_Rqmts_D-20519.htm
C:\Documents and Settings\anikora\Desktop\Complete MRO Requirements HTML Tables\MRO_L1_Level_1_Requirements_-_Appendix_to_Program_Plan_D-22204.htm
C:\Documents and Settings\anikora\Desktop\Complete MRO Requirements HTML Tables\MRO_L2.5_Project_System_Requirements_D-22212.htm
C:\Documents and Settings\anikora\Desktop\Complete MRO Requirements HTML Tables\MRO_L2_Mission_Assurance_Requirements_D-20327.htm
...
```

- Input file identified by “-pf” command line flag identifies the patterns for which the documents are to be searched. An example is shown below:

```
(\s)+[t|T]ime
(\s)+[s|S]oon
(\s)+[l|L]ate
(\s)+[e|E]arly
(\s)+[e|E]arlie
(\s)+[b|B]efore
(\s)+[a|A]fter
(\s)+[s|S]econd
(\d)+(\s)*[m*|M*][s|S]
(\s)+[m|M]icrose
(\s)+[h|H]our
(\s)+[m|M]inute
(\s)+[d|D]ay
(\s)+[m|M]onth
(\s)+[y|Y]ear
```



Requirements Decomposition Analysis

Output Files from FindPatterns.pl



KilogramSearchFrame - Netscape

File Edit View Go Bookmarks Tools Window Help

file:///C:/Documents%20and%20Settings/anikora/Desktop/Complete%20MRO%20Requirements%20HTML%20Tables/KilogramSearchFrame.html

Documents Searched

1. MRO Exhibit I - Spacecraft Requirements D-20381.htm (Link to search results)
2. MRO DAV V Design Principles Rev 1 copy to MRO 02-26-02.htm (Link to search results)
3. MRO Exhibit IV - Mission Ops Plans D-20519.htm (Link to search results)
4. MRO L1 Level 1 Requirements - Appendix to Program Plan D-22204.htm (Link to search results)
5. MRO L2.5 Project System Requirements D-22212.htm (Link to search results)
6. MRO L2 Mission Assurance Requirements D-20327.htm (Link to search results)
7. MRO L2 Project Policies D-22237.htm (Link to search results)
8. MRO L2 Project Requirements D-20454.htm (Link to search results)
9. MRO L2 Science Requirements D-22211.htm

Search Patterns

1. Kg
2. kg

Pattern Search Results

Return to the top of the page.

C:\Documents and Settings\anikora\Desktop\Complete MRO Requirements HTML Tables\MRO_L2.5_Project_System_Requirements_D-22212.htm

Filename	ID	Ancestors	Descendants	Matched Patterns, Number of Matches	Requirement Text
MRO L2.5 Project System Requirements D-22212.htm	284	1. MRO Exhibit I - Spacecraft Requirements D-20381.htm, 129 2. MRO L2 Launch Vehicle Technical Requirements D-number.htm, 43		kg, 1	The PS shall be designed for a mass
MRO L2.5 Project System Requirements D-22212.htm	1317	1. MRO Exhibit I - Spacecraft Requirements D-20381.htm, 213		kg, 1	The minimum size of an orbiter or background sequence (bits to TBS
MRO L2.5 Project System Requirements D-22212.htm	845	1. MRO L3 Payload System Requirements D-22219.htm, 45 2. MRO Exhibit I - Spacecraft Requirements D-20381.htm, 129		kg, 1	The PS shall be designed to accommodate
MRO L2.5 Project System Requirements D-22212.htm	1609	1. MRO Exhibit I - Spacecraft Requirements D-20381.htm, 129		kg, 1	The PS shall accommodate a reserve
MRO L2.5 Project System Requirements D-22212.htm	1525	1. MRO Exhibit I - Spacecraft Requirements D-20381.htm, 47	1. MRO L2 Science Requirements D-22211.htm, 1060 2. MRO L2 Science Requirements D-22211.htm, 1112	kg, 1	The PS shall create and maintain a constituents of the orbiter.
MRO L2.5 Project System Requirements D-22212.htm	1674			kg, 1	Project Mass Summary (kg) PL Allocation 139 S/C Dry Allocation 839 PM Reserve 35.5 Propellant Allocation 1149 Electra Allocation 17.5 Total 2180

Return to the top of the page.

C:\Documents and Settings\anikora\Desktop\Complete MRO Requirements HTML Tables\MRO_L2_Mission_Assurance_Requirements_D-20327.htm

Filename	ID	Ancestors	Descendants	Matched Patterns, Number of Matches	Requirement Text
No patterns matched in this document.					

Document: Done (1.763 sec)

Command line: FindPatterns.pl -df DocumentNames_3.txt -p Kg kg -o KilogramSearchFrame.html
8 June, 2004 NASA Assurance Technology Symposium 16



Help Screen – CompareResults.pl

```
Command Prompt
C:\>CompareResults.pl

This script compares two or more files obtained with either of the scripts
"TraceReqs.pl" or "FindPatterns.pl". The output is an html file identifying
the requirements common to each of the possible subsets of the specified result
files. For example, if 3 result files were specified, there would be 7
combinations of result files that would be analyzed (2**3-1). See the help
screens for "TraceReqs.pl" and "FindPatterns.pl" for detailed information on
their use.

Usage:

CompareResults.pl -i <ResultFile 1> <ResultFile 2> [<ResultFile 3> ...]
[-c|-e|-u] [-if <ResultFileNamesFile>] [-o <OutputFileName>] [-v]

where:

<ResultFile X> is the name of an html file produced with the script
"FindPatterns.pl" or "TraceReqs.pl".

<ResultFileNamesFile> is an optional file containing the names of result
files. The -if option can be used instead of or in addition to the -i option
to avoid entering a large number of result file names on the command line.

There are three choices for specifying how the results are to be compared:

-c: In each subset, look for a result, but do not check to make sure that
the result is not contained in results files that are not part of the
subset. For example, if there are four results files A, B, C, and D,
and a search is being done to find results common to B and C, this
option will not check for the nonexistence of the results in A and D.
THIS IS THE DEFAULT CHOICE FOR COMPARING RESULTS.

-e: In each subset, look for a result, and check to make sure that
the result is not contained in results files that are not part of the
subset. For example, if there are four results files A, B, C, and D,
and a search is being done to find results common to B and C, this
option will check for the nonexistence of the results in A and D.

-u: Do not compare results, but report the union of all the result files.

<OutputFileName> is an optional name for an html file that will contain the
result of running this script. The extension ".html" is added to the name of
the file. If no filename is supplied, the results are written to the
standard output.

-v denotes the verbose option. If this option is selected, progress messages
will be printed on the standard output if the -o option has also been
selected. If this option has not been selected, or if the -o option has not
been selected, no progress messages will be displayed.

C:\>
```



Requirements Decomposition Analysis

Input Files to CompareResults.pl

- Input file identified by “-if” command line flag identifies the results that are to be compared. An example is shown below:

TestMassTrace.html

KilogramSearchFrame.html

MassSearchFrame.html

- TestMassTrace is the output of the “TraceRequirements.pl” script for a set of requirements related to mass.
- KilogramSearchFrame.html is the output of the “FindPatterns.pl” script when searching all documents for either “Kg” or “kg”.
- MassSearchFrame.html is the output of the “FindPatterns.pl” script when searching all documents for either “Mass” or “mass”.



Requirements Decomposition Analysis



Output Files from CompareResults.pl

TestOutput13 - Netscape

file:///C:/Documents%20and%20Settings/anikora/Desktop/Complete%20MRO%20Requirements%20HTML%20Tables/TestOutput13.html

Results Files Compared

1. TestMassTrace.html
2. KilogramSearchFrame.html
3. MassSearchFrame.html

Subset Comparison Results

Subset 1.1.1

Contained In:

1. TestMassTrace.html
2. KilogramSearchFrame.html
3. MassSearchFrame.html

Not Contained In:

Filename	ID	Ancestors	Descendants	Requirement Text
MRO Exhibit I - Spacecraft R requirements D-20381.htm	159		<ol style="list-style-type: none"> 1. MRO Related Projects M01 Exhibit I Orbiter Req.html, 22 2. MRO L2.5 Project System Requirements D-22212.htm, 845 3. MRO L2.5 Project System Requirements D-22212.htm, 1609 4. MRO L2.5 Project System Requirements D-22212.htm, 284 	The spacecraft shall be designed for a maximum of the following allocations: Spacecraft Wet Mass - 1988.0 Kg Instruments - 139.0 Kg Electra - 17.5 Kg Project Manager Reserve - 35.5 Kg
MRO L2.5 Project System Requirements D-22212.htm	284	<ol style="list-style-type: none"> 1. MRO Exhibit I - Spacecraft R requirements D-20381.htm, 159 2. MRO L3 Launch Vehicle Technical Requirements D-number.htm, 43 		The PS shall be designed for a maximum injected
MRO L2.5 Project System Requirements D-22212.htm	845	<ol style="list-style-type: none"> 1. MRO L3 Payload System Requirements D-22219.htm, 45 2. MRO Exhibit I - Spacecraft R requirements D-20381.htm, 159 		The PS shall be designed to accommodate 156.5 kg
MRO L3 Payload System Requirements D-22219.htm	45		<ol style="list-style-type: none"> 1. MRO L2.5 Project System Requirements D-22212.htm, 845 	The payload system mass shall not exceed 139 kg
MRO Related Projects M01 Exhibit I Orbiter Req.html	22	<ol style="list-style-type: none"> 1. MRO Exhibit I - Spacecraft R requirements D-20381.htm, 159 		The maximum orbiter launch mass shall be 758 kg commanded shutdown.

Return to the top of the page.

Subset 0.1.1

Contained In:

1. KilogramSearchFrame.html
2. MassSearchFrame.html

Not Contained In:

1. TestMassTrace.html

Filename	ID	Ancestors	Descendants	Requirement Text
MRO DAV V Design Principles Rev 1 copy to MRO 02-26-02.htm	160			Because of the ambitious nature (technical and programmatic) of management is necessary to enable success. Therefore, it is prudent resources to account for and accommodate uncertainties and expense and power resources in conjunction with ample funding resources developmental and operational issues, and enable timely, balanced having to perform time-consuming trade studies to micro-manage projects can use funding to mitigate mass and/or power growth.

Subset Descriptions

1. 1.1.1
2. 0.1.1
3. 1.0.1
4. 1.1.0
5. 0.0.1
6. 0.1.0
7. 1.0.0

file:///C:/Documents and Settings/anikora/Desktop/Complete MRO Requirements HTML Tables/MRO L2.5 Project System Requirements D-22212.htm#1294

Command line: CompareResults.pl -if ResultFileNames4.txt -o TestOutput13 -e