



Mission Applications Branch Code 583

Branch Technical Status Report

September 22, 2004



Presentations

- User Requirements Development Utility (URDU)

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- MAB Project Status Overview

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User Requirements Development Utility (URDU)

Terry McRoberts

User Requirements Development Utility (URDU)

What URDU does:

- **URDU Generates ACS Baseline Requirements:**

User Requirements Developer Utility (URDU) is a tool to generate a baseline set of mission specific Attitude Control Subsystem baseline requirements which can then be edited.

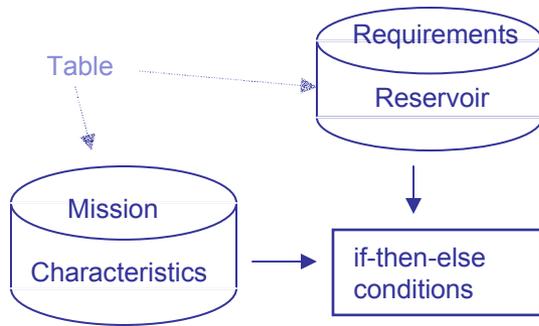
- **URDU is adaptable to change:**

The requirement selection criteria and the requirements that can be selected are also editable via the URDU Interface so that the URDU tool itself is adaptable to change and is not static.

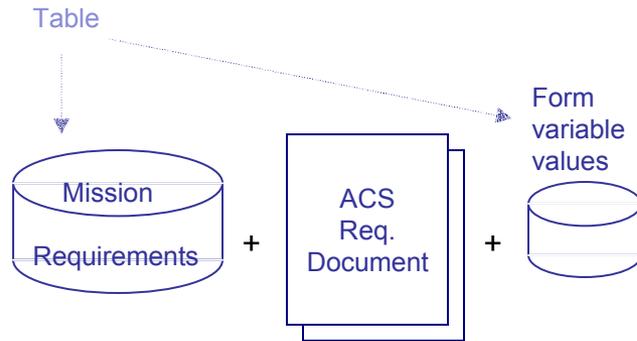
- anticipate the needs of future missions so requirements are available when needed.
- import new requirements recognized and generated by mission developers in the course of a mission.

URDU Database

Generalized



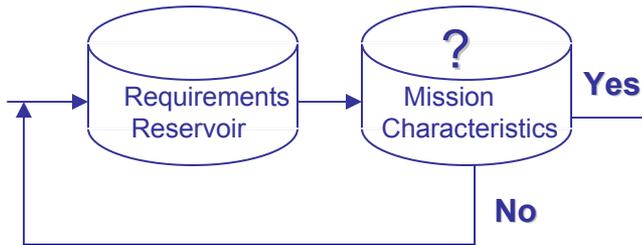
Mission Specific



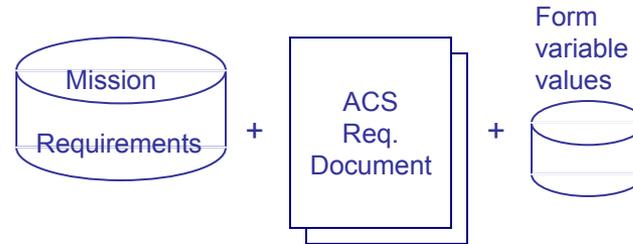
URDU uses if-then-else combinations of user-selected mission characteristics to determine which of the requirements from the requirements reservoir go into the mission requirements table. An ACS baseline requirements document is also produced. All information is stored in database tables.

URDU Databases

Administrator Database



Mission Specific Database



URDU Administrator Interface

URDU Developer Interface

URDU Interface

The Administrator interface is used to keep URDU requirements and requirement selection criteria up to date with current requirement generation demands ("living") and the Developer Interface is used to generate and edit mission requirements.

The URDU Interface has three interfaces:

- **The Mission Developer uses the:**
 - **Forms Interface:** Used to select which mission characteristics are associated with a particular mission. Used to generate the baseline ACS mission requirements.
 - **Requirements Interface:** Used to view/edit the generated mission requirements.
- **The URDU Administrator uses the:**
 - **Form editing interface:** Used to edit what mission characteristics are placed in the forms interface and to edit the requirements selection logic used to add new requirements to the generalized requirements database.

Forms Interface

Functionality

- Used to select which mission characteristics are associated with the mission.
- Used to generate the baseline ACS mission requirements.

Usability Features

- **Provides human error checks:** Checks to see whether a form was filled out completely before being submitted. Checks for more than one incidence of the word “shall” in a requirement and informs the developer if there is.
- **Helps the user organize the material:** Automatically presents the forms in order. Form titles are listed in a menu to the left of the forms. As each form is submitted the font color of the title of the form turns pale gray to indicate that the form has been submitted. User can bring up a form by clicking on the form title.
- **Remembers what the user enters:** Selected form values, as well as requirements document title page information and document name are stored in the database so that the information can be pulled up in the interface at a later time if the user wishes recreate the requirements or the baseline requirements document.

User_Interactive_Requirements_Development_Utility

File Help

Search URDU:
Advanced Search
 Go

 **Mission Forms**

Select an option:

- Basic Spacecraft and Mission
- Hardware Detail (Sensors)
- Hardware Detail (Actuators)**
- Momentum Management
- Attitude and Orbit Control
- Attitude Determination and Control

View/Edit Requirements | Mission Forms | Edit Mission Forms

Hardware Detail (Actuators)

Satellite Abbreviation:

Reaction Wheels:
Number of Wheels Wheel Bias is a function of spacecraft slew rate

Magnetic Torquer Bars:
Number of Bars Double Wound
 MTBs Used for Attitude Control

Directionally Adjustable Solar Arrays:
 Gimbal Angle Provided Gimbal Rate Provided
 Gimbal Torque Provided Redundant Gimbal Array Control Electronics

Gimballed High Gain Antennas:
 Gimbal Rate Provided Gimbal Torque Provided

Gray colored font on the form titles listed on the left of the interface informs the user that the form has been filled out and submitted. These titles can also be clicked on to revisit the form to view/edit/resubmit the form.

Requirements Interface

Functionality: Used to view/edit the baseline ACS mission requirements after they have been generated.

Usability Features:

- **Provides human error checks:**
 - Specifies to the user any inconsistencies in his/her selection of the set of mission characteristics.
 - Will request a confirmation prior to overwrite when user overwrites an existing requirement.
 - Manages parent child relationships in requirement deletion.
 - If a user attempts to delete a requirement, he/she is presented with the choice to either delete the requirement or to add the word "DELETED" in front of the requirement.
- **Helps the user to organize the material:** A table of contents of the requirements is presented on the left hand side of the screen. Clicking on a heading in the contents listing will display the requirements contained under that heading. User can also search for requirements containing a specific keyword.
- **Provides accountability:** If updates are made to the mission requirements, the interface records the identity of the author making the update based upon user logon information.
- **Provides context sensitive help:** Provides rollover descriptions of uses (i.e. balloons) of the interface components.

The screenshot displays the 'User Interactive Requirements Development Utility' window. The interface includes a menu bar with 'File' and 'Help', a toolbar with 'View/Edit Requirements', 'Mission Forms', and 'Edit Mission Forms', and a sidebar with a 'Table Of Contents' for 'SDO_ACS Requirements'. The main content area shows a list of requirements under the heading '5.1 ACS FSW Initialization'. A tooltip is visible over the requirement number '2001', containing the text 'Click to edit this requirement or this requirement number.' Below the screenshot, a text box explains that URDU has context sensitive help that appears when the mouse cursor is over various parts of the interface.

User Interactive Requirements Development Utility

File Help

SDO_ACS Requirements

View/Edit Requirements Mission Forms Edit Mission Forms

Table Of Contents:
SDO_ACS Requirements
Add a requirement
5.1 ACS FSW Initialization
5.2 ACS Sensor and Actuator
5.3 Onboard Model and Catalog
5.3.1 Spacecraft Ephemeris
5.3.2 TDRS Ephemeris (of Earth)
5.3.3 Solar Ephemeris
5.3.4 Lunar Ephemeris
5.4 Spacecraft Attitude Control
5.5 Spacecraft Total Angular Momentum
5.6 ACS Command Generation
5.7 Antenna Pointing Control
5.8 ACS Redundant Components
5.9 Failure Detection & Correction
5.10 ACS Packet Generation

Search URDU:

Advanced Search

5.1 ACS FSW Initialization

2000 Initialize ACS FSW Processing

2001 Initialize ACS FSW Processing Following "Cold" Restart

2002 The ACS FSW shall begin processing in TBR Mode following a Cold Restart.

2003 The ACS FSW data segments shall be initialized automatically following a Cold Restart, causing all variables to be reset to their preset values.

2004 Upon completion of a Cold Restart, the ACS FSW shall report its restart status in telemetry.

2005 Initialize ACS FSW Processing Following "Warm" Restart

2006 The ACS FSW shall resume execution in its current ACS control mode following a Warm Restart.

Click to edit this requirement or this requirement number.

URDU has context sensitive help. When the mouse cursor is stopped over various parts of the interface; a description of that portion of the interface's functionality is popped up for a short period of time.

User_Interactive_Requirements_Development_Utility

File Help

SDO_ACS Requirements

Table Of Contents:
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5.3.3 Solar Ephemeris
5.3.4 Lunar Ephemeris
5.4 Spacecraft Attitude Control
5.5 Spacecraft Total Angular Momentum Control
5.6 ACS Command Generation
5.7 Antenna Pointing Control
5.8 ACS Redundant Components
5.9 Failure Detection & Correction
5.10 ACS Packet Generation

Search URDU:

Advanced Search

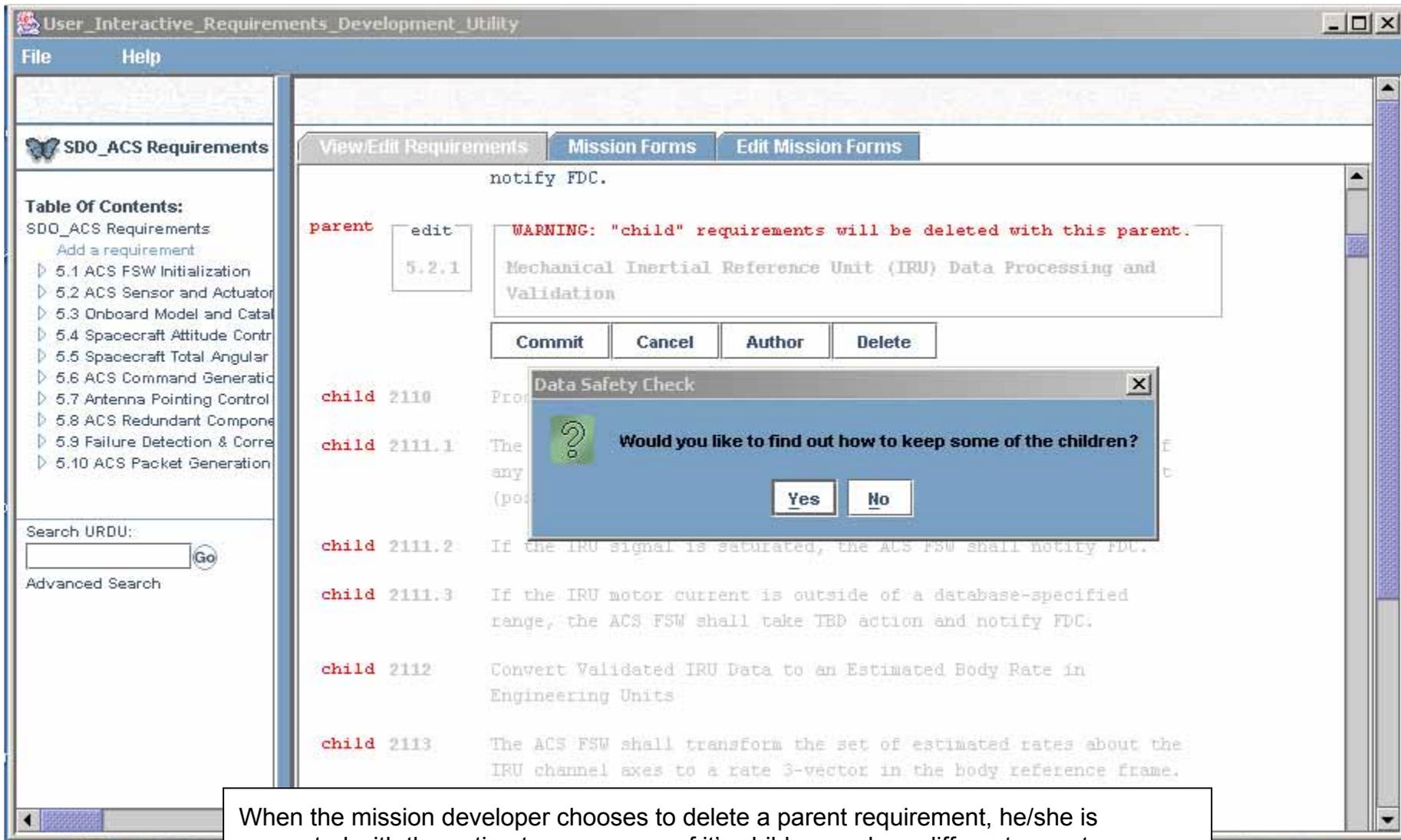
View/Edit Requirements Mission Forms Edit Mission Forms

Data Safety Check

 This data will be permanently altered in the database.
Would you like to continue?

ID	Requirement Text
2001	Initialize ACS FSW Processing Following "Cold" Restart.
2002	The ACS FSW shall begin processing in TBR Mode following a Cold Restart.
2003	The ACS FSW data segments shall be initialized automatically following a Cold Restart, causing all variables to be reset to their preset values.
2004	Upon completion of a Cold Restart, the ACS FSW shall report its restart status in telemetry.
2005	Initialize ACS FSW Processing Following "Warm" Restart

URDU provides data safety checks. When the mission developer chooses to alter a requirement, he/she is presented with a dialog box to confirm this selection.



When the mission developer chooses to delete a parent requirement, he/she is presented with the option to save some of it's children under a different parent.

The screenshot shows the 'AFS_Requirements_Generation_Tool' application window. The title bar includes 'File' and 'Help' menus. The main interface has a left sidebar with 'SDO_ACS Requirements' and a 'Table Of Contents' section. The main area contains three tabs: 'View/Edit Requirements', 'Mission Forms', and 'Edit Mission Forms'. An error message is displayed in red text: 'error 2630.3 **** Error: Have Not Specified Target Quaternion Table for Delta-V, but Functionality Was Selected Elsewhere ****'. A pop-up dialog box is overlaid on the main window, containing the text: 'There are errors in the form selections made to generate the require...'. Below this text, it says: 'Move the mouse cursor over the word 'error' (in red font) located to the left of the requirement number 2630.3 for details. Then use the forms to regenerate the requirements.' and an 'OK' button. The background shows a list of requirements, including 2631.2, 2631.3, and 2631.4. At the bottom left, there is a search box for URDU and an 'Advanced Search' option. A text box at the bottom of the image provides context: 'URDU provides feedback to the mission developer if he/she has selected an inconsistent set of mission characteristics. Each time the generated requirements are visited for viewing and/or editing the developer is warned that there is an inconsistent set of selections in the mission forms that needs to be corrected via pop-up dialog boxes like the one shown above.'

AFS_Requirements_Generation_Tool

File Help

SDO_ACS Requirements

Table Of Contents:
SDO_ACS Requirements
Add a requirement

View/Edit Requirements Mission Forms Edit Mission Forms

error 2630.3 ** Error: Have Not Specified Target Quaternion Table for Delta-V, but Functionality Was Selected Elsewhere ******

There are errors in the form selections made to generate the require...

Move the mouse cursor over the word 'error' (in red font) located to the left of the requirement number 2630.3 for details. Then use the forms to regenerate the requirements.

OK

5.10 Failure Detection & Corr
5.11 ACS Packet Generation

Search URDU: Go

Advanced Search

2631.2 After executing the Delta-V commands, but before exiting Delta-V Mode, the ACS FSW shall report (in telemetry) that it is in the Orbit Maneuver Completed State.

2631.3 The ACS FSW shall execute Delta-V commands having time duration equal to the maximum time specified in Ref. ___ (GN&C requirements document) or less.

2631.4 The ACS FSW shall report issued Delta-V thruster commands in telemetry.

URDU provides feedback to the mission developer if he/she has selected an inconsistent set of mission characteristics. Each time the generated requirements are visited for viewing and/or editing the developer is warned that there is an inconsistent set of selections in the mission forms that needs to be corrected via pop-up dialog boxes like the one shown above.

Form Editing Interface

Functionality

- **Edit mission characteristics reservoir:** Used to edit the database table containing the variables used to populate the mission characteristics forms. The forms located in the “Forms Interface” are populated from these variables at run time and presented to the mission developer for selection of mission dependent characteristics.
- **Edit generalized requirements reservoir:** This interface can also be used to edit the requirements reservoir and the combination of mission characteristics required to select a requirement out of the requirement reservoir.

Usability Features

- **Provides human error checks:** Provides a double check on the deletion or change of a mission characteristic: Requires the user to view (or choose to skip viewing) all requirements associated with a mission characteristics prior to changing or deleting the mission characteristic.
- **Not yet completed:** ...

Search URDU:
Advanced Search
 Go

- Mission Forms**
- Select an option:
- Basic Spacecraft and Mission
 - Hardware Detail (Sensors)
 - Hardware Detail (Actuator)
 - Momentum Management
 - Attitude and Orbit Control**
 - Attitude Determination and Control

 **Attitude Determination and Control Function Options**

Satellite Abbreviation:

Fine Pointing Science

Add form component

- Delete/Edit Wheel Bias is a function of spacecraft slew rate
- Delete/Edit For Velocity Abberation
- Delete/Edit For Continuous Dither
- Delete/Edit For Velocity Abberation
- Delete/Edit For Parallax
- Delete/Edit Target Pointing Support Slewing
- Delete/Edit For Continuous Dither

- Delete/Edit For Parallax
- Delete/Edit Apply Feedforward Torque
- Delete/Edit For Gravity Gradient
- Delete/Edit For Solar Pressure

- Delete/Edit Sci_FeedForward_MTB

Earth Pointing (Allowed Observers)

Add form component

- Delete/Edit Yaw Bias Allowed
- Delete/Edit Feedforward Adjustment for Gravity Gradient

- Delete/Edit Feedforward MTB

Project Completion Status:

The **URDU Mission Developer** Interface is completed. It has the following features as were specified in the URDU requirements document:

- Generate and output baseline FSW mission requirements.
- The URDU will have a user interface which provides the user with the capability to add and edit requirements and document text, print or browse the FSW project requirements document, and create reports of the requirements in the databases.
- Output can be directed to the screen, or to a MS Word file or printer and will have the numbering and appearance of Appendix A of the URDU requirements document.
- Will be capable of storing and managing multiple FSW projects. A form will be provided for the entry of a new requirement or editing of an existing requirement. A mechanism for the deletion of an existing requirement will be provided.
- Provides user access controls by password protection.
- Provide context sensitive help capability.

- The URDU shall ensure that requirement numbering is preserved within the FSW mission database when spacecraft characteristics are re-selected, and the reuse requirements are regenerated.
- Search engine functions will be provided.
- Will manage parent-child relationships for update and deletion of requirements.
- Deleted requirements will be displayed but marked as "DELETED."
- Will provide the ability to manage multiple sets of mission requirements. These sets would correspond to the mission FSW document releases.

The **URDU Administrator** Interface is underway: What follows is a description of the multiple functions provided by this interface:

- In order to allow the URDU administrator to be able to correlate combinations of spacecraft characteristics (also known as the form options) to the selection of specific reuse requirements an interface is provided for the URDU administrator to add new spacecraft characteristics or requirements, alter or delete existing spacecraft characteristics or requirements, and correlate combinations of characteristics to requirements. **Underway will be done by end of Feb. 2005**

- Modifications to the FSW characteristics database will cause regeneration of the spacecraft characteristics user interface displays. [Done](#)
- Access to FSW characteristic display changes and database will be restricted to the URDU requirements administrator. [Done](#)

System testing, system updates: System testing will start in October. The requirements and database will be updated as a result of discussions about changes to the requirements in the SDO project. [Timeline unknown](#)