AN INTEGRATED DESIGN ENVIRONMENT FOR SMALL SATELLITE DESIGN

Fall 2004 Report

Presented to Dr. Dan Simon

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ABSTRACT

VIKSAT is a series of small satellites being designed and developed by the Center for Research in Electronics and Aerospace Technology (CREATE) with support from the NASA Glenn Research Center and the Industrial Space Systems Lab (ISSL) at Cleveland State University (CSU). In this work, a Knowledge Capturing Integrated Design Environment (KCIDE) is developed for the design of small satellites, in order that the students at CSU can gain industrial experience with satellite design and with an integrated design environment.

This paper mainly discusses the creation of the integrated design environment (IDE) for using the software involved in each phase of satellite development. In addition, the phases involved in designing and operating small satellites are illustrated. The IDE developed will allow users to design and build small satellites and allows for ready retrieval of satellite design information. The IDE when installed over a network allows users to work on any satellite design phase they wish and users can work on more than one phase simultaneously.

ISSUES

The main purpose of this project is to develop an Integrated Design Environment (IDE) for satellite design and development. Currently VIKSAT1, the first of the VIKSAT series, is being developed as a laboratory model (see Figure 1). The main goals of the project are:

- Creating a software platform that integrates the various software systems (e.g., Cradle, Software Tool Kit (STK), Ansoft, Solid Works) that are required for satellite design.
- Integrating various analysis tools, capturing design rules and decreasing development time.
- Incorporating IDE with knowledge capture to obtain KCIDE for satellite design.

Figure 1: Image of VIKSAT1, the first of the VIKSAT series.
INTRODUCTION

SIX PHASE DESIGN FOR SATELLITES

In general the design of satellites would involve a lot of phases which are developed in stages [1]. But for the VIKSAT IDE we follow a six stage development which is divided into the following stages, as shown in Figure 2:

1. **Concept**
   
   Preliminary studies are usually done in this stage. Primary questions include cost and schedule.

**Figure 2**: High level diagram of the VIKSAT IDE

2. **Definition**

   A. The technical and business baselines for the spacecraft project are defined.
   
   B. The user provides the requirements for ‘requirement elicitation’ to develop the satellite. These requirements need to be modified over time depending on the progress of the project.

3. **Design**

   The various subsystems involved in designing a satellite are designed, built and tested in this phase. These include

   - Command and Control (Electrical)
   - Communication Subsystem
   - Payload Subsystem
   - Mechanisms and Deployment Subsystem
   - Power Subsystem
   - Thermal Management Subsystem
   - Propulsion and Orbit Maintenance
   - Structure (Mechanical)
4. Development

A. In this phase, assembly, test and launch operations take place (ATLO).
B. Once the subsystem units are assembled, system level tests include.
   - Thermal testing, simulating space.
   - Mission simulations.
   - Acoustics, simulating the environment in shroud.

5. Operations

A. This stage starts immediately after the launch of the spacecraft.
B. The mission operations include the control and command of the spacecraft.
C. Depending on the complexity of the spacecraft and the mission, the mission operations team is defined.

6. Disposal

This phase is useful in design of the techniques required for the disposal of the spacecraft.

RESULTS FOR FALL 2004

- Literature review for the IDE project was done [2].
- The first phase, i.e., The CONCEPT phase is finished with the integration of Microsoft Project with Microsoft.Net.

Figure 3: Screenshot of the VIKSAT IDE
SOFTWARE PLATFORM

The VisualBasic.Net Framework [3] is chosen as the software platform onto which the required software for satellite missions is integrated. A screenshot of software is as shown in above Figure 3.

FUTURE WORK

For Spring 2005 it is planned to work on the Concept phase and some of the subsystem designs.

After finishing the preliminary work, this project can be upgraded to real world application for communication with the spacecraft (at least to meet some functions of the spacecraft). This IDE can be linked with a database for file system management. In addition this software needs to be used over a network.

CONCLUSIONS

This IDE is aimed at designing space missions which could include more than one spacecraft. Also this IDE will include knowledge capture.

REFERENCES

