ANTENNA STABILIZATION CONTROLLER BASED ON *intel80960 KB* 32-BIT RISC

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INTRODUCTION

The Antenna Stabilization Controller based on *Intel 960MC/KB* 32-bit RISC processor preliminary design consists of Servo Motor, Resolver, Tacho Generator and Power Amplifier for realization of the two axes closed loop servo system. The antenna angles in azimuth and elevation need to be commanded from On Board Computer (OBC) after resolving through proper axes system. In the actual implementation stage the OBC and the Stabilization Controller communicate through MIL-STD-1553B serial bus. An antenna that is placed on the Stabilization Controller [1] tracks the moving targets in space. The system is directly mounted on the vehicle. The system needed to be isolated from motion of the vehicle body. The Stabilization Controller is commanded from the Inertial Navigation System (INS). Accurate body rates in pitch and yaw measured by INS are used for this purpose. INS body rates at sampling interval of 2 msec. Digital communication provisions are required in the servo controller as well as with the resolver, which produces accurate position information of the gimbals. Angle information is digitally processed to achieve highly accurate antenna position also under the severe vehicle disturbance conditions.

Mechanical design of antenna housing with two axes control is performed and hardware realized. Elevation and Azimuth motors with corresponding resolver and tachos are integrated on the gimbals to perform servo testing.

Two closed loop controller [2] is implemented for each axis. For the initial part of the development of this Stabilization Controller the inner rate loop of the controller is implemented in analog and the outer position loop in digital. Also according to the requirements the system is designed in such a way that is stabilizing both the azimuth and elevation axes one after another.

GUI based Ground Checkout System to check the health status of the system. The RS 232 & MIL-STD-1553 based serial communication interfaces implemented for the interconnection between the Antenna Stabilization Controller and the GUI.

ANTENNA STABILIZATION CONTROLLER

Antenna Stabilization Controller setup is shown in the following fig 2.0. This setup consists of a Stabilization Controller over that an antenna is mounted and an i960 based Controller used to control the Stabilization Controller. The basic building blocks of the Antenna Stabilization Controller based on *i960 MC/KB* 32-bit RISC processor as shown in fig. 2.1. There are two axes azimuth and elevation in the Antenna Stabilization Controller, each axis is controlled by a two-loop Digital PI Servo Controlling [2] technique. The inner rate loop is formed by the Motor with Load, Tacho, error amplifier, compensator and power amplifier, the outer position loop is formed by the Resolver, Resolver to Digital Converter (RDC) and processor. The Resolver measures the gimbals' angle, which is digitized by a standard two channel RDC. The digital control law resides in the *i960* [3] based Servo controller. The Digital PI Servo Controller reads angle command from OBC through 1553B bus, gimbals' angle from RDC, and generates angular error, which is then passed through the control law to generate gimbals' rate command. This digital rate command is transformed to analog signal using standard Digital to Analog Converter (DAC) and is given to the analog rate loop. The gimbals' rates are measured by the Tachos, rate commands and Motor currents need to be telemetered during flight. An eight channel Analog to Digital Converter (ADC) converts these data into digital form and is sent to telemetry through 1553B bus directly or through OBC. The ground checkout system is connected with this serial link.

The Salient Features of the Controller

a)Programmable Interrupt Controller is for interrupt based serial communication

b)Programmable Timer Interrupt to generate the required timings.
c)Watch dog Timer based Supervisor circuit and external reset circuit.
d)EPLD based chip select signal generation,
e)128Kx32 E^2PROM and 128Kx32 SRAM.
f)MIL-STD-1553B serial bus, ADC, DAC, RDC interfaces and RS 422 link for GCS

GROUND CHECKOUT SYSTEM

Ground Checkout System (GCS) is also a part of the controller system, which is used to find out the health status of the system. This Checkout System is palced at the ground station not in the vehicle where the Stabilization Controller is mounted. For finding the health status in the early part of the research work, the Antenna Stabilization Controller interfaced through the RS 232 - RS 422 - RS 232 communication interface protocol standard. Later on the system is giving the status information through the MIL - STD - 1553B bus interfacing circuit. When the vehicle is in space the communication between the ground checkout system and the Antenna Stabilization Controller is achieved by processing the IR signals sent from the vehicle. In this setup the PC which is loaded by the GCS called as BC and the Antenna Stabilization Controller as RT.

Requirement List for the GCS:

- ❖Read the data from memory locations
- ❖Write the data into memory locations
- ❖Read the ADC input data
- ❖Write the DAC output data
- ❖Read the RDC data
- ❖Perform Self Test

Detailed Design of the GCS

For all the operations mentioned below first we have to get the information about the communication port which is used for the Serial Communication (whether COM1 or COM2) ports. Also we have to generate for each and every operations corresponding ASCII code for the operation which is going to takes place as said above in the requirement list. Then convertion process of the 8-bit data format for all the processes because in the PC communicates wih the Antenna Stabilization Controller through the RS-232 Serial Communication. In the later part of the implementation the Communication is based on the MIL-STD-1553 based Serial Communication. For this also the Communication Protocol is designed as Device Driver Technique using VC++.

Here with the detailed software design obtained before implementing for this GUI based GCS, It is designed that GCS can be developed using VB / VC++. For the effective device driver operations and the Real Time Software implementation of this GCS is implemented using VC++. The Interface Protocol is also developed for the RS232 based Serial Communication for the GUI of GCS with the Antenna Stabilization Unit.

CONCLUSION

An interrupt-based firmware [3] is designed and implemented for the Digital PI Servo Controller. The Digital Control Law is implemented based on the *i960 MC* 32-bit RISC architecture. The Stabilization system is controlled by both the inner and outer loops of the Elevation and Azimuth Axes in high accurate and speed as the required. The loop timing is achieved as required 2 m.sec for the outer loop and 0.5 m.sec for the inner loop of both axes. Also a GUI based Ground Checkout Software is designed and developed. The GCS is used to know the updated health status of the Controller by the user. RS 232 Serial Communication protocol is implemented using VC++ for the Communication between the Controller and GCS. According to the requirements MIL-STD-1553B bus serial interface protocol is also implemented to communicate with the Antenna Stabilization Controller. In future the Digital Control Law can be implemented based on AD 21060 SHARC Processor and the Noise present in the Inner gimbal will also be reduced.

References

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