

ASTRODATA: LOW COST AUTOMATION FOR HAVANA RADIOASTRONOMICAL STATION

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Abstract: This paper is about Low Cost Automation. In it, a basic background about Havana Radioastronomical Station is described. It is showed a Real Time Supervisory and Control System named Astrodata. The System employs Virtual Instruments and Distributed I/O. Transfer information from sensors to computer it is made by communication network. Astrodata creates a database for off-line data processing. Data's primary processing is made by system on-line.

Keywords: Antennas, Computer applications, Distributed computer control systems, Networks, Real time computer systems.

1. INTRODUCTION

The Havana Radioastronomical Station was founded in 1969 by Cuban-Soviet initiative. It observes the solar radioemission in five frequencies and it made reports to the Solar Patrol Service Net (World Data Center B).

There are three Radiotelescopes. They work on 5 different frequencies. Havana's Radiotelescopes, whose work on frequencies of 15.0, 9.5 and 6.7 GHz, are based on Dike type receivers. They measure total and circularly polarized radioemission. The last radiotelescope is a switch interferometer and it work on frequencies of 280 and 230 MHz. Regular observations, with time resolution of 1 second are

suitable for solar activity studies and magneto-ionic alert services.

On early eighties, it was implemented an automatic system for data acquisition on the Havana Radioastronomical Station. It was based on ISKRA 1256 machines. Principal problems were the mnemotecnic language (ISKRA) and non-possibility of updating system.

A new Supervisory and Control System named Astrodata has developed. It use:

- Communication serial network between 19 points and PC. Network is based on ADAM (Analog Digital Analog Module) from

Advantech Co., Ltd. (Advantech Co., Ltd., 1997).

- Personal Computer (Celeron, 800 MHz, 128 Mbytes RAM, 20 GBytes HD).
- Windows 2000 Professional Operating System from Microsoft Corp.
- Real Time Application Software developed on LabWindows/CVI from National Instruments Corporation (National Instruments Corporation, 1999).

New technology was introduced and many old problems were resolved.

2. PROBLEMS AND SOLUTIONS

Many problems must be resolved to obtain a low cost automation solution for a Radioastronomical Station:

- The first problem is optimization of operation works.
- The second one is optimization of preliminary data processing.
- The last one is to create a database free compatible with another software's used by Astronomic Research Team.

The Cost of our solutions, to these problems, are under \$ 6 000.00 USD.

The solutions to each problem are explained below:

- Optimization of operation works. It is resolved with a set of Virtual Instruments (VI). Each operation like: Calibration, Positioning, Observation and Measure have associated many VI. By this way, information obtained from sensors and necessary actions on radiotelescopes are resolved with help of our System. Observation and Measure operation are resolving with the same VI.
- Preliminary data processing was not implemented in old automation versions of Station. Then operators during Observation and Measure actions must be calculating: mean values, variances, minimum and maximum values. With our solution these statistics are calculated on line.
- ASCII format and a very simple structure with many records for general information,

one record with names and many others records for values is our solution to last problem. This database can be access from practically any other software. It has 14 column arrays with 36 000 measurements each. This is 10 hours of measurements per days. It store 5 882 Mbytes per year.

Data post processing is made by specialized software off-line.

These solutions satisfy client's requirements.

3. IMPLEMENTATION AND RESULTS

Solutions implementation was possible with help of ADAM interfaces, communication network, PC and LabWindows/CVI version 5.5.

ADAM (Analog Digital Analog Module) is a set of intelligent sensor to computer interface modules containing built in microprocessor. They are remotely controlled through a set of command issued in ASCII format and transmitted in RS-485 protocol. They provided signal conditioning, isolation, ranging, A/D and D/A conversion, data comparison, and digital communication functions. They are used for analog and digital signals.

Astrodata network employ:

- 2 x ADAM 4017 with 8 analog inputs each.
- 3 x ADAM 4050 with 7 digital inputs and 8 digital outputs each.

Measured variables are listed in table 1 and manipulated variables in table 2.

Table 1. Measured variables.

Variable	Antenna
Total radioemission	15 GHz
Circularly polarized radioemission	15 GHz
Radiotelescope temperature	15 GHz
Total radioemission	6.7 GHz
Circularly polarized radioemission	6.7 GHz
Radiotelescope temperature	6.7 GHz
Total radioemission	9.5 GHz
Radiotelescope temperature	9.5 GHz
Total radioemission	280 MHz
Total radioemission	230 MHz
Radiotelescope temperature	230 MHz
Sky luminosity	
Environment temperature	

Many digital inputs are used for extreme Radiotelescope positions detect.

Antennas are included on Radiotelescope. Antennas of 15 GHz and 6.7 GHz are included on Radiotelescope RT3. Antenna of 9.5 GHz is included on RT2. Antennas of 280 MHz and 230 MHz are included on RT1.

Table 2. Manipulated variables.

Variable	Radiotelescope
Input voltage to tracking motor	RT3
Input voltage to positioning motor	RT3
Input voltage to tracking motor	RT2
Input voltage to positioning motor	RT2
Input voltage to tracking motor	RT1
Input voltage to positioning motor	RT1

Many digital output signals are used to chance input signals attenuation.

The RS-485 network provides lower-noise sensor readings, as modules can be placed much closer to the source.

The host computer is connected to the RS-485 network with one of its COM ports through the ADAM 4520, RS-232/485 converter. Only two wires are needed for the RS-485 network and communication may be until 1 200 meters without repeater. Inexpensive shielded twisted pair wiring is employed, IEG 332.3 CEI 20-22. The baud rate used is 38 400.

Real Time System Astrodata has the following structure:

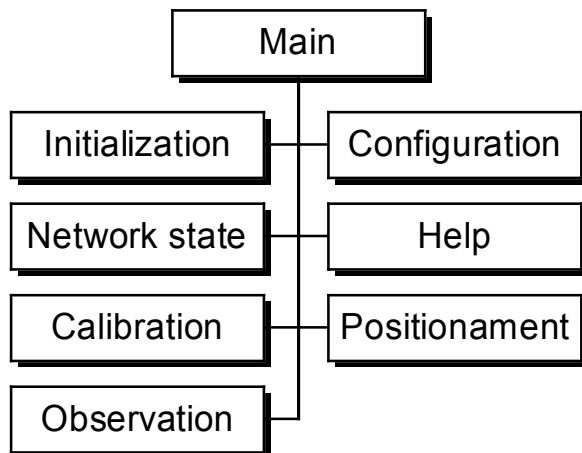


Fig.1.- Real Time System Astrodata structure.

Where for example Observation block include different task reported in table 3.

Table 3.- Task of Observation block.

Order	Task
1	Data acquisition or simulation (training).
2	Filtering and units conversions.
3	Statistics calculus
4	Display reports
5	Measured data disk storage
6	Positioning and tracking control

Man – Machine interface for main VI is shown in figure 2. Where instrument options are on left part.



Fig.2.- Main Virtual Instrument.

In figure 3 is showed initialization interface using VI concepts.



Fig. 3.- Variables Initialization.

