Astronomy for the developing world
IAU Special Session no. 5, 2006
J.B. Hearnshaw and P. Martinez, eds.

doi:10.1017/S174392130700676X

Application of the Field System-FS9 and a PC to the antenna control unit interface in radio astronomy in Peru

Erick Vidal[1], José Ishitsuka[1,2] and Yasuhiro Koyama[3]

[1]Instituto Geofísico del Perú,
Calle Badajoz 169, Urb. Mayorazgo IV Etapa, Ate-Vitarte, Lima 3, Perú
email: evidal@axil.igp.gob.pe

[2]National Astronomical Observatory of Japan,
2-21-1 Osawa, Mitaka, Tokyo 181-8588, Japan
email: pepe@hotaka.mtk.nao.ac.jp

[3]National Institute of Information and Communications Technology
893-1 Hirai, Kashima, Ibaraki, Japan
email: koyama@nict.go.jp

Abstract. We are in the process to transform a 32m antenna in Peru, used for telecommunications, into a Radio Telescope to perform Radio Astronomy in Peru. The 32m antenna of Peru constructed by NEC was used for telecommunications with communications satellites at 6 GHz for transmission, and 4 GHz for reception.

In collaboration of National Institute of Information and Communications Technology (NICT) Japan, and National Observatory of Japan we developed an Antenna Control System for the 32m antenna in Peru. It is based on the Field System FS9, software released by NASA for VLBI station, and an interface to link PC within FS9 software (PC-FS9) and Antenna Control Unit (ACU) of the 32 meters antenna.

The PC-FS9 controls the antenna, commands are translated by interface into control signals compatibles with the ACU using: an I/O digital card with two 20bits ports to read azimuth and elevation angles, one 16bits port for reading status of ACU, one 24bits port to send pulses to start or stop operations of antenna, two channels are analogue outputs to drive the azimuth and elevation motors of the antenna, a LCD display to show the status of interface and error messages, and one serial port for communications with PC-FS9.

The first experiment of the control system was made with 11m parabolic antenna of Kashima Space Research Center-NICT, where we tested the right working of the routines implemented for de FS9 software, and simulations was made with looped data between output and input of the interface, both test were done successfully.

With this scientific instrument we will be able to contribute with researching of astrophysics. We expect to into a near future to work at 6.7GHz to study Methanol masers, and higher frequencies with some improvements of the surface of the dish.

Keywords. Masers, radio-astronomy, astronomy in Peru

1. Introduction

Based on a 32m antenna used for satellite communications will be converted into a radio telescope just implementing few functions to the tracking system. This proceeding explains briefly about development of an interface to make the antenna to track celestial bodies that will be useful for radio astronomy.

Figure 1. Laptop Compaq nx9005 running Field System FS9

2. Field system FS9

Field System FS9 released by NASA for VLBI stations is a free license software that runs on GNU Linux Debian. Field System FS9 was made to administrate VLBI equipments, using: GPBI, and SERIAL interfaces, is also flexible to use other input output ports as LAN data exchange, only implementing necessary codes.

Now a days Field System FS9 is being used in many radio observatories, that allow us join them for coordinated observations.

2.1. *Installation of the field system FS9.*

Installing FS9 system is not difficult and it would be easily made with the following steps:

(*a*) Implement a Desktop PC
(*b*) Install Linux Debian OS
(*c*) Configure environment for Field System FS9 with FSADAPT
(*d*) Install Field System FS9
(*e*) Configure hardware settings
(*f*) Configure procedure files
(*g*) Write program for local station.

See Figure 1.

2.2. *Linking PC - FS9 and 32-m antenna*

According to technical information of Nippon Electric Company, the antenna maker, it is not possible to exchange control signals to the ACU trough serial RS-232 or parallel connection with any other device, it is because the antenna was built for geostationary satellites. However mechanics of antenna allows to be used for continuous tracking movements, as we need for astronomical observations.

3. Interface

3.1. *Interface overview*

Based on the requirements of Field System FS9, and the mode of operations of 32m antenna of Peru, it was necessary to build an interface to translate instructions of Field

https://doi.org/10.1017/S174392130700676X Published online by Cambridge University Press

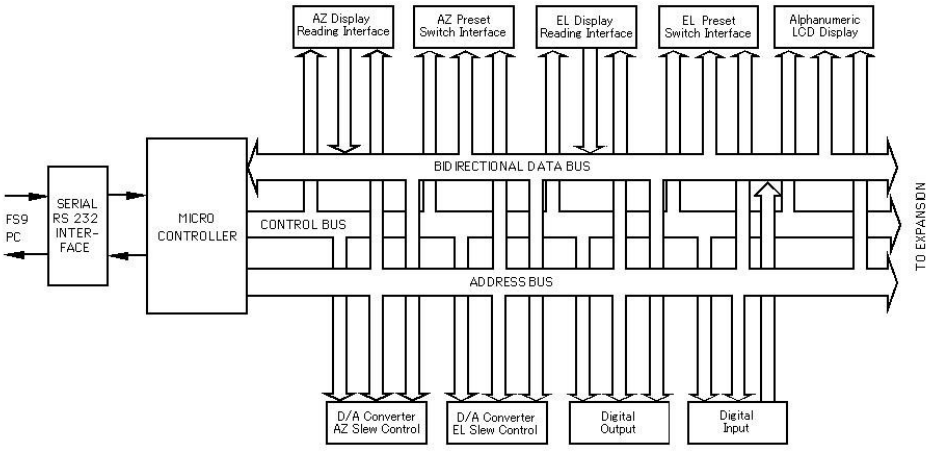

Figure 2. Block diagram of interface.

System FS9 control system to the ACU. The interface device must be able to translate serial text format commands into: digital pulses, analog signal and Binary Coded Decimal (BCD) data. Also read analog, digital and BCD information from the control panel of antenna and translate to the equivalent text format information compatible with Field System FS9.

3.2. *Design of the hardware*

Based on the capabilities of the antenna control system and operations mode of 32m antenna of Peru, the interface must be implemented with a microprocessor. The Interface includes the following ports to interact between PC-FS9 and ACU.

- Processor:
  - RISC micro-controller: Controller of interface.
- Input/Output Ports:
  - Serial RS-232 Interface: PC- FS9 communication port
  - 1 Digital input: State reading of ACU
  - 1 Digital Output: Command send to ACU
  - 2 Channel analog output: Slew control
  - 2 Channel parallel output: New angle data for antenna
  - 2 Channel parallel input: Read current angle of antenna
  - 1 Alphanumeric LCD: Display interface state
  - Expansion port: Future use.

See the Figure 2.

4. Interface software

4.1. *Implementing the software*

Interface device will control the ACU receiving information trough serial RS-232 port and changing the text instructions into analog and digital signals to slew azimuth and elevation motors, activate, deactivate functions of antenna, get status information from the panel of the ACU and encode the read status to text commands compatible with FS9 control system.

https://doi.org/10.1017/S174392130700676X Published online by Cambridge University Press

5. Conclusions

Lately many large parabolic antennas that was used for satellite communications are discontinued, and no longer used. Most of antennas were designed just for geostationary satellites, and they are not implemented with tracking software neither to remote control the antenna, even though their mechanical systems are capable to do it. Present document shows that it is possible to do, attaching the appropriate hardware and making a communications antenna working for radio astronomy.

Appendix A. Technical information of the 32-m antenna

- Type :Cassegrain
- Diameter :32m
- Max speed : 0.3deg/s
- Frequency :4GHz Tx, 6GHz Rx
- Antenna Mount :Wheel & Track
- Main Dish accuracy
  - Without wind :1.0mm rms
  - Winds 13 to 20m/s :1.26mm rms

Appendix B. Technical Information of the Interface

- Main Processor :PIC16F877
- I/O Ports:
  - Digital
    - two 20bit (Az, El read)
    - one 16bit (Status read)
    - one 24bit (control to ACU)
  - Analog
    - two 16bit D/A converter (drive Az/El)

Appendix C. Control computer

- Hardware
  - Compatible IBM Personal Computer
  - GPIB Card
  - Serial Interface
- Hardware
  - Operative System :Linux Debian
  - Control Software :FS9 Field System

Acknowledgements

For making possible developing radio astronomy in Perú, I would like to thank to: Consejo Nacional de Ciencia y Tecnología Concytec - Perú, for financing my air ticket to Prague, to Instituto Geofísico del Perú - IGP, for allowing me to participate at IAU-GA-2006, National Astronomical Observatory of Japan NAOJ, for financing partially my stay in Prague. People of Radio Astronomy Application Group of National Institute of Information and Communications Technology NICT - Kashima, Japan for their encourage and kindness during my stay in Japan for constructing Peruvian Antenna's interface.