

## Fortaleza Station Report for 2009

*Pierre Kaufmann, A. Macílio Pereira de Lucena, Adeildo Sombra da Silva,  
C. Guillermo Gimenez de Castro*

### Abstract

This is a brief report about the activities carried out at the Fortaleza geodetic VLBI station (ROEN: Rádio Observatório Espacial do Nordeste), located in Eusébio, CE, Brazil, in 2009. The observing activities consisted of 52 VLBI sessions and continuous GPS monitoring recordings. The installation of optical fiber was completed, and the station switched to a 1 Gbit/s high speed network, to be used in e-VLBI operations. Regular GPS observations were carried out at the same site. A major mechanical failure of the antenna positioner has interrupted observations in November 2009.

### 1. General Information

The Rádio Observatório Espacial do Nordeste, ROEN, located at INPE facilities in Eusébio, nearly 30 km east of Fortaleza, Ceará State, Brazil, began operations in 1993. Geodetic VLBI and GPS observations are carried out regularly, as contributions to international programs and networks. ROEN is part of the Brazilian space geodesy program, which was initially conducted by CRAAE (a consortium of the Brazilian institutions Mackenzie, INPE, USP, and UNICAMP) in the early 1990s. The program began with antenna and instrumental facilities erected, with activities sponsored by the U.S. agency NOAA and the Brazilian Ministry of Science and Technology's FINEP agency. ROEN is currently coordinated by CRAAM, Center of Radio Astronomy and Astrophysics, Engineering School, Mackenzie Presbyterian University, São Paulo, in agreement with the Brazilian National Space Research Institute, INPE. The activities are currently carried out under an Agreement of Cooperation signed between NASA—representing research interests of NOAA and USNO—and the Brazilian Space Agency, AEB, lasting until 2011. Under the auspices of the NASA-AEB Agreement, a new contract was signed between NASA and CRAAM, Mackenzie Presbyterian Institute and University to extend partial support to the activities until 2014. The remainder of the operational costs, staff, and infrastructure support are provided by INPE and by Mackenzie.

### 2. Component Description

The largest instrument of ROEN is the 14.2 m radio telescope, an alt-azimuth positioner. It is operated at S- and X-bands, using cryogenic radiometers. The system is controlled by the Field System, Version 9.9.2. Observations are recorded with a Mark 5 system. One Sigma-Tau hydrogen maser clock standard is operated at ROEN. GPS monitoring is performed within a cooperative program with NOAA (USA). There is a Leica System 1200 installed at the station that operates continuously. The collected data are provided to the NOAA/IGS center and to the Brazilian IBGE center. ROEN has all basic infrastructures for mechanical, electrical, and electronic maintenance of the facilities.



Figure 1. Main entrance of the Fortaleza station.



Figure 2. 14.2 m Fortaleza antenna taken under a coconut tree.

### 3. Staff

The Brazilian space geodesy program is coordinated by Prof. Pierre Kaufmann, who is Brazil's AEB representative in the NASA-AEB Agreement. The coordination receives support from the São Paulo office at CRAAM/Instituto and Universidade Presbiteriana Mackenzie, with scientific assistance from Prof. C. Guillermo Gimenez de Castro, Dr. Claudio E. Tateyama, and partial administrative support from Valdomiro S. Pereira. Partial technical assistance is occasionally given by technical staff from the Itapetinga Radio Observatory near São Paulo, also operated by INPE/Mackenzie. The Fortaleza Station facilities and geodetic VLBI and GPS operations are managed on site by Dr. A. M. P. de Lucena (CRAAE/INPE), assisted by Eng. Adeildo Sombra da Silva (CRAAE/Mackenzie), and technicians Avicena Filho (CRAAE/INPE) and Carlos Fabiano B. Moreira (CRAAE/Mackenzie).

### 4. Current Status and Activities

#### 4.1. VLBI Observations

Fortaleza participated in geodetic VLBI experiments as detailed in Table 1 for the year 2009.

Table 1. 2009 session participation.

Experiment	Number of Sessions
IVS-R1	19
IVS-R4	25
IVS-T2	01
IVS-R&D	04
IVS-OHIG	03

## 4.2. Development and Maintenance Activities in 2009

Considerable attention was given to technical maintenance, especially to the following activities:

- 1) Maintenance of the cryogenic system,
- 2) Replacement of Mark IV video converters and rack power supplies,
- 3) Maintenance of the Mark 5 recorder and disc pack modules,
- 4) Update of Mark 5 operational system and software for testing the high speed network,
- 5) Repair of receiver temperature controller,
- 6) Tests of the high speed network for e-transfers and e-VLBI,
- 7) Maintenance of the Web site (<http://www.roen.inpe.br>) and the local server computer,
- 8) Repair and alignment of azimuth gear box,
- 9) Adjustment of elevation and azimuth motor electronics, and
- 10) Diagnostic activities performed trying to identify a problem on azimuth bearing.

## 4.3. GPS Operations

The IGS network GPS receiver operated regularly at all times during 2009. Data were collected and uploaded to an IGS/NOAA computer.



Figure 3. Detail of GPS antenna placed over the main building.

## 4.4. High Speed Network

During 2009, we kept testing the performance between Fortaleza/Eusébio (ROEN) station, which is connected to the RNP (Rede Nacional de Pesquisas—Brazil National Research Network) and Haystack Observatory. We also started performance tests with the VLBI Correlator at Bonn (UBonn/BKG) and with Australia (CSIRO/ATNF). The data rates we obtained were at 255 Mbps on average with Australia; problems related to the traffic of UDP packages did not permit us to get a measurement of the network performance between Fortaleza and the German correlator. Some interconnection problems were detected and are being solved to improve that performance.

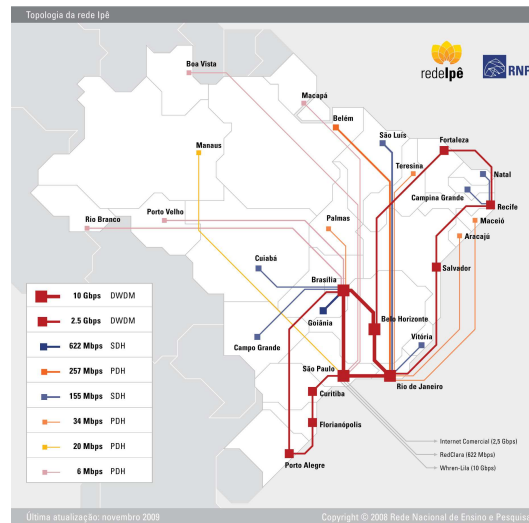


Figure 4. Structure of the Brazilian National Research Network (RNP) ([http://www.rnp.br/\\_media/graficos/backbone-rnp-200911.jpg](http://www.rnp.br/_media/graficos/backbone-rnp-200911.jpg)).

#### 4.5. Meetings, Visits and Collaborations

In April 2009, a meeting between ROEN staff, the Director and staff members of the National Research Network (RNP), and researchers of the Presbyterian University Mackenzie was held in São Paulo to discuss strategies to diagnose and enhance the high speed connection.

ROEN was present at the 8th International e-VLBI Workshop, June 22-26, 2009, Madrid, Spain, organized by the Instituto Geográfico Nacional in cooperation with the EXPReS project, by one member of the office in São Paulo. A staff member of the RNP was also present. During the meeting, a collaboration with the ATNF was initiated to carry on observations.

Between August 25-28, IVS Chair Dr. Harald Schuh visited ROEN where he presented two talks related to VLBI. The opportunity was used to meet ROEN staff, solve some problems related to the high speed tests, and discuss new collaboration plans.

#### 5. Future Plans

The optimized high speed optical network connection will allow ROEN to participate in e-VLBI experiments. The tests for improvement of the network data rates are currently being carried out. One interesting possibility is the installation of a software correlator at Mackenzie University. At the moment the University does not have permanent access to the RNP backbone. Tests to qualify the present high speed connection Mackenzie/Fortaleza are under way.

#### 6. Acknowledgements

These activities have received partial support from NASA, within an agreement with the Brazilian Space Agency (AEB) and a contract with Mackenzie, as part of an agreement between Mackenzie and INPE.