

# Fortaleza Station Report for 2017 and 2018

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**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, during the period from January 2017 until December 2018. The total observed experiments consisted of 192 VLBI sessions, including the CONT17 campaign and continuous GPS monitoring recordings. About 95% of VLBI recorded data was transmitted through a high-speed network.

## 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, and 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

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Paulo, in agreement with the National Institute for Space Research (INPE). The activities are currently carried out under an Agreement of Cooperation which was signed between NASA—representing research interests of NOAA and USNO—and the Brazilian Space Agency (AEB) and which was extended until 2021. Under the auspices of the NASA–AEB Agreement, a contract was signed between NASA and CRAAM (Mackenzie Presbyterian Institute and University) to partially support the activities at ROEN. In 2014, the contract was renewed for five more years.

The counterpart of the operational costs, staff, and support of infrastructure are provided by INPE and by Mackenzie.



Fig. 1 14.2-m radio telescope.

## 2 Main Instruments

The largest instrument at ROEN is the 14.2-m radio telescope on an alt-azimuth positioner. It is operated at

S- and X-bands using cryogenic radiometers. The system is controlled by the Field System, Version 9.11.19. Observations are recorded with a Mark 5A system and transmitted via high-speed network to the correlators in the U.S. (WACO and Haystack), to Bonn in Germany, or to SHAO in China at rates about 220 Mbps.

The 1-Gbps link was accomplished in 2007. It is integrated into and sponsored by the Brazilian Research Network (RNP).

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.

### 3 Staff

The Brazilian space geodesy program was coordinated by Dr. Pierre Kaufmann, who was Brazil's AEB representative in the NASA-AEB Agreement. Unfortunately Dr. Kaufmann passed away in February 2018. Dr. Jean-Pierre Raulin is the current coordinator of the geodesy program.

The coordination receives support from the São Paulo office at CRAAM/Instituto and Universidade Presbiteriana Mackenzie, with administrative support from Valdomiro M. S. Pereira and Lucíola Russi. The Fortaleza Station facilities and geodetic VLBI and GPS operations are managed on site by Dr. Antonio Macilio Pereira de Lucena (CRAAE/INPE), assisted by Eng. Adeildo Sombra da Silva (CRAAE/Mackenzie), and the technicians Emerson Costa (CRAAE/Mackenzie), Kelvin de Oliveria (CRAAE/Mackenzie), and Francisco Renato Holanda de Abreu (CRAAE/Mackenzie).

## 4 Current Status and Activities

### 4.1 VLBI Observations

In 2017 and 2018, Fortaleza participated in geodetic VLBI sessions as described in Table 1.

**Table 1** 2017 and 2018 session participation.

Session type	Number of sessions
IVS-R1	69
IVS-R4	84
IVS-T2	3
R&D	9
CRF	5
OHIG	10

### 4.2 CONT17 Campaign

In 2017, Fortaleza participated in the CONT17 campaign recording 12 days. Although a mechanical problem in the antenna occurred during the campaign, it was resumed after a complete evaluation of the antenna.

### 4.3 Operational and Maintenance Activities

The summary of activities performed in the period is listed below:

1. Repair and maintenance of the following equipments: cryogenic system, Mark 4 acquisition system, Mark 5A recorder, antenna mechanical and electrical systems, angle encoders system, receiver telemetry, man lift platform and thermoelectric receiver temperature control system.
2. Installation of a new Mark 5 unit that is being used exclusively for data transfers.
3. Evaluation of the current status of the main bearing through mechanical measurements and grease chemical analysis.
4. Installation of new grease lines circuit for main bearing lubrication.
5. Repair of electrical motors and gear boxes of antenna drives.
6. Operation and maintenance of geodetic GPS (NOAA within the scope of NASA contract).
7. Operation and maintenance of power supply equipment at the observatory (main and diesel driven standby).
8. Transferring of recorded data through high-speed network.

#### **4.4 GPS Operations**

The IGS network GPS receiver operated regularly at all times during 2017 and 2018. Data were collected and uploaded to IGS/NOAA.

#### **6 Future Plans**

Discussions are under way with Brazilian as well as international partners to raise funds for a new, VGOS-compatible system to be erected at the Fortaleza VLBI station facilities.

#### **5 In Memoriam**

These few lines are a special homage to the memory of Prof. Pierre Kaufmann, a founder of the Brazilian space geodesy program, who went through all possible journeys and fights to make all this real.