

Fortaleza Station Report for 2019 and 2020

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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 2019 until December 2020. The total observed experiments consisted of 174 VLBI sessions and continuous GPS monitoring recordings. All VLBI recorded data was transmitted through 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, 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 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, 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 2019, 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.

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 through a high-speed network either to the correlators in the U.S. (WACO and Haystack), to Bonn in Germany, or to SHAO in China at rates of about 220 Mbps.

For this, a 1-Gbps link has been available since 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

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Fig. 1 The 14.2-m radio telescope at Fortaleza Station.

IBGE center. ROEN has all basic infrastructures for mechanical, electrical, and electronic maintenance of the instrumental facilities.

3 Staff

Dr. Raulin Jean-Pierre is the current coordinator of the space-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 (CRAAM / INPE), assisted by Eng. Adeildo Sombra da Silva (CRAAM / Mackenzie), and the technicians Emerson Costa (CRAAM / Mackenzie), Kelvin de Oliveira (CRAAM / Mackenzie), and Francisco Renato Holanda de Abreu (CRAAM / Mackenzie).

4 Current Status and Activities

4.1 VLBI Observations

In 2019 and 2020, Fortaleza participated in the geodetic VLBI sessions described in Table 1.

Table 1 Fortaleza's VLBI session participation in 2019 and 2020.

Experiment	Number of Sessions
IVS-R1	60
IVS-R4	81
IVS-T2	6
R&D	16
OHIG	11

4.2 Operational and Maintenance Activities

A summary of activities performed in the report period is listed below:

1. The main bearing of the antenna failed at the end of 2020. Staff effort is important to collect all necessary info to figure out the best alternative to repair the antenna in terms of quality of material, services, and cost.
2. Repair and maintenance of the following equipments: cryogenic system, Mark IV acquisition system, Mark 5A recorder, antenna mechanical and electrical systems, angle encoders system, receiver telemetry, and the receiver thermoelectric temperature control system.
3. Repair of electrical motors.
4. Operation and maintenance of geodetic GPS (NOAA within the scope of NASA contract).
5. Operation and maintenance of power supply equipment at the observatory (main and diesel driven standby).
6. Transferring of recorded data through high-speed network.

4.3 GPS Operations

The IGS network's GPS receiver operated regularly at all times during 2019 and 2020. Data was collected and uploaded to an IGS/NOAA server.

5 Future Plans

Discussions have already started among the Brazilian groups and with international partners to raise funds for a new VGOS-compatible system to be installed at the Fortaleza VLBI station facilities.