Universidad de Alicante VLBI Analysis Center (UAVAC) Report

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1 Abstract

This report describes the VLBI Analysis Center in Alicante and its activities done in 2022 with the aim of becoming an operational certification body. The main objective of the VLBI Analysis Center in Alicante is to analyze all IVS sessions, to regularly send data and analysis products to the IVS Combination Center, and to research and develop models and software to improve the VLBI technique.

2 Introduction

In the first quarter of 2022, we began taking the first steps towards becoming an operational Analysis Center (AC), with the ultimate goal of being a full contributor to future ICRF and ITRF realizations, as well as operational products such as IVS combined EOP products. In this report, we present our group, our technical hardware and software, and our current activities to the community.

3 Alicante Analysis Center Staff

The staff currently consists of five people:

- Jose Manuel Ferrándiz: group leader, EOP theory
- Maria Karbon: Reference frames, operational data analysis, and software development
- Santiago Belda and Alberto Escapa: EOP modeling and theory
- Juan Antonio Martínez Marín: IT and hardware.

Fig. 1 Front row, left to right: Jose Manuel Ferrándiz, Maria Karbon, Santiago Belda; back row, left to right: Alberto Escapa, and Juan Antonio Martínez Marín.

We have a close cooperation with GFZ (GeoForschungsZentrum Potsdam), making efforts to improve the CPO models and validating our results by performing VLBI analysis. Together with GFZ and BKG, we are also participating in the IERS Second EOP Prediction Comparison Campaign. Further, we have close collaborations with the IGN (Instituto Geográfico Nacional), namely Esther Azcue Infanzón and Víctor Puente García, as well as with Mariana Moreira working at the VLBI station on Santa Maria, within the RAEGE project. The aim is sharing know-how and to make the best use and retrieve the most scientific output from the available infrastructure.

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4 RAEGE

RAEGE began in 2011 with a Memorandum of Understanding between the Government of the Azores and the Government of Spain to install a VLBI observing network to meet the international requirements required for VGOS, the global VLBI observing system. RAEGE stands for "Red Atlántica de Estaciones Geodinámicas y Espaciales" in Spanish and "Rede Atlântica de Estações Geodinâmicas e Espaciais" in Portuguese.

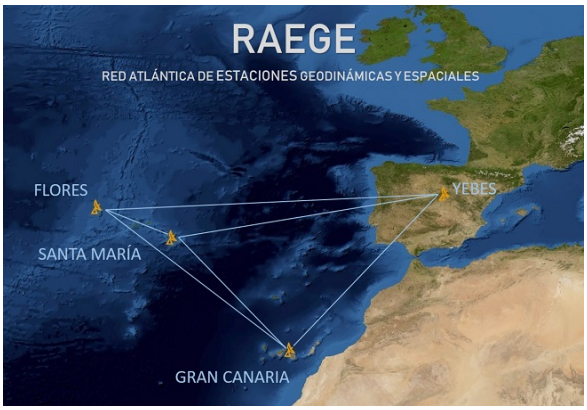

Fig. 2 The RAEGE network (`https://www.ign.es/web/resources/COP25/geodesiaespacial.html`)

Figure 2 shows the final configuration of the network; Yebes and Santa Maria are currently operational, Gran Canaria is starting construction, and Flores is in the planning phase. Where possible, VLBI stations are complemented by GNSS, SLR, and superconducting gravimeters. For more information see [López-Pérez, J.A. et al. (2022)] and references therein. The main feature of the RAEGE core sites is their location on three different tectonic plates (Figure 2): the Eurasian plate (Yebes Observatory, Spain), the North American tectonic plate (Flores, Azores), and the African tectonic plate (Gran Canaria, Canary Islands and Santa Maria, Azores), the latter station being on the Azores microplate. This network will go a long way in constraining plate motions, particularly the rotation of the African plate, where we only have one VLBI observatory in South Africa, as well as a notoriously poor network of GNSS stations. It will also provide participating institutions with extensive scientific skills related to hardware and software development, model extension and testing, conducting custom observing sessions, and more.

5 Hard- and Software

By summer 2022, we installed our first server dedicated mainly to operational analysis: a generic commercially manufactured Linux machine with a 500 GB hard drive (expansion in progress) to which we automatically download the VLBI databases and all required auxiliary files.

On this machine we maintain a frozen version of our analysis software. The upload to the IVS Combination Center is also carried out from this PC. For our operational analysis we are currently using the Vienna VLBI software VieVS, version 3.2. In the future we also plan to use PORT [Schuh et al. (2021)], a VieVS derivative developed at the GFZ. In addition, we are developing a Kalman filter solution in-house to be able to automate analysis as much as possible in near real time [Karbon et al. (2014)].

6 Main Research Topics

The main research activities and results of the UAV IVS Analysis Center during 2022 included:

- EOP prediction
  - implementation of machine-learning techniques
  - active membership in the EOP Prediction Comparison Campaign and the hosting of two related workshops in Alicante
- CPO and FCN related research
  - reevaluation of the nutation theory
  - improved modeling of the FCN
- ICRF related research
  - handling of source position variations
  - comparison and combination of radio source catalogs

7 Current Status and Future Plans

In 2022 we dedicated most of our time to the setup of our hard- and software and to re-analyzing the VLBI data archive, also in view of the ITRF2020 reprocessing. Finally, in March 2023 we are submitting our VLBI analysis results to the IVS Combination Center on a regular basis.

We will continue our fundamental research focused on precession nutation theory, free core nutation, and the celestial reference frame. Our goal is to improve these individual components and therefore all dependent parameters, and to propose methods to improve their consistency and methods for their reliable prediction. In software development, we strive for independence from external tools and as much automation as possible. Furthermore, we intend to take full advantage of the facilities provided by RAEGE and therefore propose our VLBI observations to demonstrate the capabilities of the network, also in combination with other stations. Because some of the RAEGE stations will host not only a VLBI antenna and a GNSS receiver but also an SLR station or a superconducting gravimeter, we strive to directly or indirectly connect these technologies and to extend a technology by using the incorporated information obtained from the others.

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