Improving the sensitivity levels generated from hypothesis testing by combining VLBI with GNSS data

Pakize Küreç Nehbit\textsuperscript{1,2}, Susanne Glaser\textsuperscript{2}, Kyriakos Balidakis\textsuperscript{2}, Pierre Sakic\textsuperscript{2}, Robert Heinkelmann\textsuperscript{2}, Harald Schuh\textsuperscript{2,3}, and Haluk Konak\textsuperscript{1}

\textsuperscript{1}Department of Geomatics Engineering, Kocaeli University, Kocaeli, Turkey
\textsuperscript{2}Organisation of the Helmholtz-Centre Potsdam, Geodesy, Potsdam, Germany (nehbit@gfz-potsdam.de)
\textsuperscript{3}Chair of Satellite Geodesy, Institute of Geodesy and Geoinformation Science, Technische Universität Berlin, Germany

The individual space geodetic techniques have different advantages and disadvantages. For instance, the global observing network of Very Long Baseline Interferometry (VLBI) consists of much fewer stations with a poorer distribution than the one of Global Navigation Satellite Systems (GNSS). In a combination thereof, this fact can be compensated, mainly to the benefit of the former.

The sensitivity level provides information on the detection capacity of observing stations based on undetectable gross errors in a geodetic network solution. Furthermore, sensitivity can be understood as the minimum value of the undetectable gross errors by hypothesis testing. The location of the station in the network and the total weight of its observations contribute to the sensitivity levels thereof. Also, the total observation number of a radio source and the quality of the observations are critical for the sensitivity levels of the radio sources. Besides these criteria, a radio source having a larger structure index has a larger sensitivity level. In this study, it is investigated whether the sensitivity levels of VLBI stations in the CONT14 campaign improve by combination with GNSS. The combination was done at the normal equation level using 153 GNSS stations in total, 17 VLBI radio telescopes, and local ties at 5 co-located stations which are ONSA-ONSALA60, NYA1-NYALES20, ZECK-ZELENCHK, MATE-MATERA, and HOB2-HOBART26 during the CONT14 campaign spanning 15 days. To evaluate the observations of GNSS and VLBI, the software of EPOS8 and VieVS@GFZ (G2018.7, GFZ, Potsdam, Germany) were used respectively. In the VLBI-only solution, FORTLEZA shows the poorest sensitivity level compared to the other VLBI radio telescopes. As a result of the combination with GNSS, it can be seen that the sensitivity levels of FORTLEZA improved by about 60\% in all sessions of CONT14. It can be concluded that VLBI stations, which are poorly controlled by the other radio telescopes in the network, can be supported by the other space geodetic techniques to improve the overall quality of the solution.