



## **GIOVE Orbit and Clock Determination Based on the CONGO Network**

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As a prototype for the satellites of the future European Global Navigation Satellite System (GNSS) Galileo, the European Space Agency (ESA) launched two satellites (GIOVE-A and GIOVE-B) as part of the Galileo in Orbit Validation Element (GIOVE). To gain experience with the signals transmitted by these satellites and to estimate satellite orbit and clock parameters, a global network of GIOVE-capable receivers was established. This Cooperative Network for GIOVE Observations (CONGO) is operated by Deutsches Zentrum für Luft- und Raumfahrt (DLR, Oberpfaffenhofen, Germany) and Bundesamt für Kartographie und Geodäsie (BKG, Frankfurt, Germany) in cooperation with several local station hosts.

The CONGO network currently consists of 10 globally distributed stations providing their observations in real-time. This network is used by Technische Universität München for an operational daily orbit and clock determination of the GIOVE satellites including orbit predictions. The strategy of the combined GPS and GIOVE processing is presented. The quality of the estimated GIOVE satellite orbits is evaluated by orbit fits and satellite laser ranging (SLR). The quality of the GIOVE satellite clocks, in particular the hydrogen maser of GIOVE-B, is discussed. As three different receiver types and two different satellite systems are considered in the CONGO processing, a special focus has to be put on the biases between the different receivers and GNSSs.

Additionally, DLR's Real-Time Clock Estimation (RETICLE) system has been extended to provide clock offset estimates for the GIOVE satellites based on the real-time data streams from the CONGO network. The GIOVE clocks are estimated based on the predicted orbits mentioned above. The paper introduces the real-time clock estimation process and presents real-time clock results.