REPORT ON THE FENNOSCANDIAN-JAPANESE PROJECT FOR NEAR REAL-TIME UT1-OBSERVATIONS WITH E-VLBI

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ABSTRACT. The Fennoscandian-Japanese project for near real-time UT1-observations with e-VLBI is a collaboration between the VLBI research groups at the telescopes Onsala (Sweden), Metsähovi (Finland), Kashima (Japan) and Tsukuba (Japan). Several UT1-sessions were observed during 2007 and the e-VLBI data technology was applied to send in real-time the Fennoscandian data to software correlators in Japan where the data were correlated with the Japanese data in near real-time. The final UT1 estimates were available in the best cases already within 30 minutes after the end of a one hour long observing session. The latency of the UT1 measurement could thus be improved dramatically compared to the regular Intensive sessions (INT) of the International VLBI Service for Geodesy and Astrometry (IVS). The accuracy of the derived UT1 values was confirmed to be as accurate as the combined solution of International Earth Rotation Service (IERS).

1. MOTIVATION AND INTRODUCTION

Geodetic Very Long Baseline Interferometry (VLBI) is one of todays most important geodetic space technique for the determination of Earth orientation parameters (EOP). It is of major importance in particular for UT1 and nutation. The International VLBI Service for Geodesy and Astrometry (IVS) organizes daily UT1 observations in the so-called Intensive-series (INT). These sessions are usually observed during one hour with two stations that form a long east-west baseline. However, the final UT1 results from these INT sessions are usually not available before several hours to days after observation, mainly due to delays in data transfer and data correlation. Thus, any application that demands accurate close to real-time UT1 values, e.g. space navigation, suffer from this high latency and so far depends on UT1 predictions, e.g. the IERS Bulletin-A predictions.

In order to improve the latency of UT1 results and to study systematic influences on the VLBI derived UT1 results, the VLBI research groups at the Kashima Space Research Center (Japan), the Geographical Survey Institute at Tsukuba (Japan), the Onsala Space Observatory (Sweden) and the Metsähovi Radio Observatory (Finland) started a project in early 2007 to measure UT1 with e-VLBI.

The four research groups operate VLBI telecopes that are used for geodetic VLBI and have access to international high-speed optical fibre networks at data rates of at least 1 Gbit/sec. Furthermore, operate the two Japanese groups software-correlators that were developed at Kashima and allow near real-time correlation. These pre-requisites make it possible to perform e-VLBI experiments.

2. OBSERVATIONS AND RESULTS

The Fennoscandian-Japanse e-VLBI UT1 measurements were started in April 2007 using the VLBI network shown in the left graph of Figure 1. Between April and December 2007 more than 20 sessions were observed, and different observing setups with data rates of 128 Mbps, 256 Mbps and 512 Mbps were tested. In all sessions the observational data from Onsala and/or Metsähovi were sent in real-time or close to real-time with the data transfer protocol "Tsunami" via high-speed optical fibre networks to Kashima and/or Tsukuba where the data were correlated with software-correlators. After the near real-time correlation, the data were analyzed with a VLBI data analysis software. For several of the sessions, the final UT1 results were derived already 30 minutes after the end of the observations. This is a new record for ultra-rapid UT1 measurements.

The derived UT1 results have formal errors on the order of a few microseconds to several tens-microsecond. The agreement between the e-VLBI derived UT1 results and the final IERS EOPC04 values is on the order of a few microseconds to several tens-microsecond, too. The right graph in Figure 1 shows as an example the e-VLBI UT1 results obtained during the first half of 2007 together with IERS Bulletin-A predictions and IERS EOPC04 final results. The e-VLBI UT1 results agree well with the final IERS EOPC04 values, while the prediction values degrade rapidly.

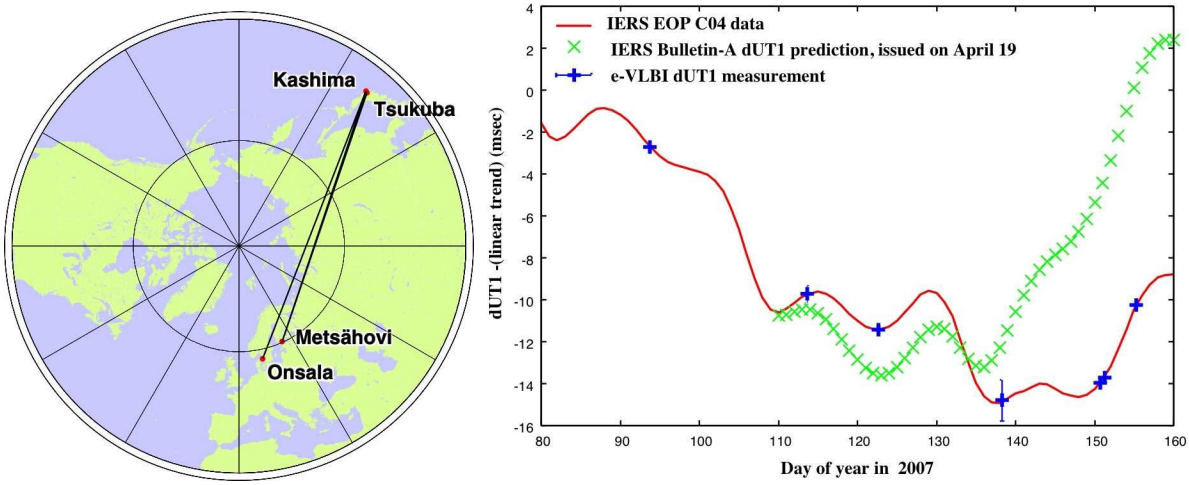

Figure 1: Left: VLBI-network for the Fennoscandian-Japanese project for near real-time UT1-observations with e-VLBI. Right: e-VLBI UT1 results (blue dots with error bars) during the first half of 2007 compared to IERS EOPC04 values (green crosses) and IERS Bulletin-A predictions (red line).

3. CONCLUSIONS AND OUTLOOK

The Fennoscandian-Japanese e-VLBI UT1 project is very successful and provides accurate UT1 results with low latency. We demonstrated that e-VLBI UT1 results can be derived within 30 minutes after an observing session of one hour. Observing data rates of 128 Mbps, 256 Mbps and 512 Mbps have been applied successfully. The agreement between the e-VLBI derived UT1 values and the IERS EOPC04 values is within several tens-microsecond. Thus, our e-VLBI results provide the same level of accuracy as IERS EOPC04 already with observations on just a single baseline.

We will continue this successful project and focus in the future on:

1. the investigation of systematic errors in UT1 estimation by inter-comparison of results derived on parallel baselines as well as other IVS routine session
2. the consistency of ultra-rapid UT1 results with standard IVS results
3. the impact of different data rates and scheduling options on the UT1 results