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Determination and prediction of EOP using Kalman filtering

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The necessity to observe and predict short term variations in the Earth's rotation in near real-time has increased significantly over the last decades, in particular in regard to satellite navigation and positioning and tracking of interplanetary spacecrafts. As the orientation of the Earth changes unpredictably in a rapid and irregular manner, the observation of extra-terrestrial objects from the Earth are affected by such variations and a precise knowledge of these changes is needed.
Geodetic Very Long Baseline Interferometry (VLBI) is one of the primary space geodetic techniques providing the full set of Earth Orientation Parameter (EOP) and it is unique for observing long term Universal Time (UT1) and nutation. Also other space geodetic techniques, such as Global Navigation Satellite Systems (GNSS) , Lunar Laser Ranging, and Satellite Laser Ranging, are able to determine the EOP as well. The challenge lies in the combination of these various EOP series as each technique is sensitive to a different subset or linear combination of the EOP also the precision of the determination differs between the techniques as well as the temporal density of the data.
Within the project VLBI-Art an elaborate Kalman filter is developed to determine and predict EOP through combining data sets from various techniques by implementing stochastic models to account statistically for unpredictable changes in EOP. Furthermore, atmospheric angular momentum calculated from numerical weather models are introduced to supplement the short-term prediction of UT1 and polar motion, making use of the high correlation between these parameters. The potential of incorporating additional data like ring-laser gyroscope observations will be investigated. This Kalman filter will be extended and embedded in the newly developed Vienna VLBI Software (VieVS) as a completely automated tool enabling it to analyze VLBI in near real-time, providing all the parameter of interest with the highest possible accuracy.