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Error assessment of local tie vectors in space geodesy

Jana Falkenberg (1), Robert Heinkelmann (2), Harald Schuh (1,2)

(1) Technische Universität Berlin, Department for Geodesy and Geoinformation, Berlin, Germany (jana.falkenberg@web.de),
(2) GFZ Potsdam, Geodesy and Remote Sensing, Potsdam, Germany

For the computation of the ITRF, the data of the geometric space-geodetic techniques on co-location sites are combined. The combination increases the redundancy and offers the possibility to utilize the strengths of each technique while mitigating their weaknesses. To enable the combination of co-located techniques each technique needs to have a well-defined geometric reference point. The linking of the geometric reference points enables the combination of the technique-specific coordinate to a multi-technique site coordinate. The vectors between these reference points are called "local ties". The realization of local ties is usually reached by local surveys of the distances and or angles between the reference points. Identified temporal variations of the reference points are considered in the local tie determination only indirectly by assuming a mean position. Finally, the local ties measured in the local surveying network are to be transformed into the ITRF, the global geocentric equatorial coordinate system of the space-geodetic techniques.
The current IERS procedure for the combination of the space-geodetic techniques includes the local tie vectors with an error floor of three millimeters plus a distance dependent component. This error floor, however, significantly underestimates the real accuracy of local tie determination. To fullfill the GGOS goals of 1 mm position and 0.1 mm/yr velocity accuracy, an accuracy of the local tie will be mandatory at the sub-mm level, which is currently not achievable. To assess the local tie effects on ITRF computations, investigations of the error sources will be done to realistically assess and consider them. Hence, a reasonable estimate of all the included errors of the various local ties is needed. An appropriate estimate could also improve the separation of local tie error and technique-specific error contributions to uncertainties and thus access the accuracy of space-geodetic techniques.
Our investigations concern the simulation of the error contribution of each component of the local tie definition and determination. A closer look into the models of reference point definition, of accessibility, of measurement, and of transformation is necessary to properly model the error of the local tie. The effect of temporal variations on the local ties will be studied as well. The transformation of the local survey into the ITRF can be assumed to be the largest error contributor, in particular the orientation of the local surveying network to the ITRF.