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GEOCON: Geodetic System Ties Using a CubeSat Constellation

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The accuracy of the Terrestrial Reference Frame (TRF), the foundation for geolocating all Earth Observations, is currently limited by systematic errors in tying together the contributions from the different geodetic techniques. Site ties using local surveys are currently limited by uncertainties in the relative position of the physical survey points and the typically inaccessible measurement reference points of the instruments. We are investigating the development of a new measurement concept using one or more space-based reference points (satellites) to significantly reduce the errors in the site ties between co-located geodetic ground stations. The proposed concept uses a novel idea of upconverting the Global Navigation Satellite System (GNSS) signal received at the satellite and transponding it to a Very Long Baseline Interferometry (VLBI) antenna ground station. This approach does not require the satellite to be in view of more than one VLBI station at a time, allowing the use of Low Earth Orbits. This is advantageous since it opens up the possibility of using inexpensive CubeSats or other small satellites, making it feasible to implement a cost-effective constellation of such satellites (GEOCON) to provide better global coverage and further improve the accuracy of the site ties for the Global Geodetic Observing System—GGOS, stations' network. With the recent successes by NASA and others in implementing new broadband VLBI stations, now is an ideal time to determine the potential of using co-location in space to reduce the site tie errors. It is particularly important to understand how the observations will be made and any potential impact on the ground station and network requirements.

We are currently developing the VLBI-GNSS measurement concept and, through analysis and simulations, we assess its potential impact on the Terrestrial Reference Frame. The simulations will take into account SLR measurements to the GEOCON CubeSats and the geodetic satellites. A thorough measurement error analysis is underway to determine the intrinsic precision of the measurement technique. Through these analyses, we will determine if there are any additional requirements needed on the ground station hardware to support this new type of observable.

The outcome of the simulations will be valuable in assessing not only this measurement concept, but also other similar co-location in space concepts (e.g. Geodetic Reference Antenna in Space or GRASP) and their potential impact on the ITRF. Further combination with the network simulations already performed by NASA's Space Geodesy Project will assess the impact of new and upgraded co-location sites on the ITRF. The new measurement concept has the potential for not only improving the ties between the different geodetic techniques, but also improving all other Earth observations through the improved ITRF. This presentation will introduce the GEOCON concept and preliminary results on the system design and initial simulations.