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Reference Station Selection for Improved Geometric Spacing During Baseline Processing in OPUS

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The National Geodetic Survey (NGS) designed, implemented and continues to operate a web-based GPS processing tool known as the Online Positioning User Service (OPUS). There are several versions of OPUS in operation, mainly because no one algorithm is optimized to process GPS data collected between 15 minutes and 48 hours. For short duration datasets, NGS designed OPUS Rapid Static (OPUS-RS), a version that uses up to nine CORS located nearby to interpolate the ionosphere around the rover. OPUS Static (OPUS-S) on the other hand, is one of the most heavily used versions of OPUS and processes datasets that span between two and 48 hours in duration. OPUS-S chooses five nearby CORS to form individual baselines with the rover and then each is processed independently. The latest version of OPUS to be presented here is OPUS Networks (OPUS-Net) and is currently in beta testing. OPUS-Net selects up to 10 IGS reference stations and three regional CORS to perform a simultaneous least squares adjustment with the rover dataset. For OPUS-Net, the three CORS are primarily used to better estimate the troposphere while the position of the unknown station and the three CORS are determined from the more precisely known and monitored IGS reference stations.

All versions of OPUS require sets of baselines between the rover and reference stations which have known positions and velocities. Because of the nature of atmospheric corrections during relative positioning, evenly-spaced geometric distribution will result in the most stable and reliable solutions. We have developed an algorithm to choose reference stations with the best geometric distribution at a given location. Rather than selecting the stations by distance, the new algorithm builds station lists by azimuth groups (zones) and selects the closest station in a zone. The process is repeated until a predefined number of stations have been selected in each zone. Also, additional functionality has been added for the operational environment such as to exclude stations when they fail the quality check, a discontinuity has been detected or to replace a station with one of the spares in the same zone.

Interpolative Dilution of Precision (IDOP) is a variable quantifying the geometry of the reference stations being used for the network. To evaluate the new reference station selection module for OPUS, IDOP is compared with the old distance-based method for each location. Positions and standard deviations for stations are also compared in several geometrically extreme cases such as coastal and high latitude regions as well as in and around tectonically active areas.