Motivation | Why proposing Dynamical Elevation Masks (dynMsk)?

Challenges at urban GNSS sites
- Urban environments challenging for stable and continuous GNSS signal acquisition.
- Intensive station selection possibly not avoid moderate numbers of obstacles at some GNSS sites.
- Classical elevation masks increase risk to erase useful geometry & observations (i.e. not suitable for urban geometry and obstruction situation).

Advantages of dynMsk
- Dynamic and adaptive elevation mask (dynMsk) considers C/N0 power density ratio as quality indicator.
- Noise on double difference observed-minus-computed (DD OMC) and carrier-to-noise (C/N0) pattern reduced.
- Useful tool during data cleaning & outlier removing to improve quality and reliability of estimated parameters.

Requirements for dynMsk
- Consistent receiver-antenna C/N0 reference curve (from absolute antenna calibration) due to individual properties.
- GNSS data (more than 2 hours) and repetition with different satellite geometry to apply dynMsk.

GNSS Challenges and Obstructions in Inner Cities

C/N0 Template Functions

Evaluation using calibrated C/N0 reference curves
- Individual receiver-antenna combinations, consistent C/N0 reference curves required.
- Separation of outliers by threshold of ±3 dB.
- Writing azimuthal and elevation dependent obstruction mask & RINEX files.

Obtained obstruction masks by dynMsk during 4 hour sessions (repeated)
- Physically meaningful, entire location fully considered.
- Distortions on carrier phase observable correspond to C/N0 identified easily by dynMsk.
- Challenging obstructions at GNSS sites GRZ, HH01, and HH05 (ref. Fig. 3).

dynMsk | Observation Domain

Why proposing Dynamical Elevation Masks (dynMsk)?

Figure 1: Carrier-to-Noise power density ratio (C/N0) as signal quality indicator, (a) nominal reference curve from laboratory network and 24 hour observation set, (b) observed C/N0 at GRZ/HH02 (Bad Frankenhausen) with the same receiver-antenna combination influenced by urban reflection.

Figure 2: Evaluation dependent C/N0 template functions obtained by robot based antenna calibration on a zero baseline approach for several antenna-receiver combinations, (a) Leica AD753 antenna, (b) Trimble Zephyr I Geodetic.

Figure 3: Selected obstruction-sets of sites used in urban GNSS monitoring sites (selected) for characterizing urban challenges, (a-c) Bad Frankenhausen (Thuringia), (d) Flensburg (Grubi Flottbek).

Figure 4: Improvements by applying dynMsk on selected baselines on the monitoring network in Bad Frankenhausen, (a) multipath linear combinations, (d-f) varied outliers identified by bad C/N0 values (black) provides reduced noise on observations (gray) at low elevations.

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Figure 5: GPS L1 OMC for selected baselines in Bad Frankenhausen w/ applying dynMsk at both sites, (a-c) baselines SL03-GP1, (b) baselines SL03-GR2. Light grey dots show DD OMC obtained by dynMsk, black dots show observables, erased by dynMsk.

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Figure 6: GPS L1 OMC for selected baselines in Bad Frankenhausen w/ applying dynMsk at both sites, (a-c) baselines SL03-GP1, (b) baselines SL03-GR2. Light grey dots show DD OMC obtained by dynMsk, black dots show observables, erased by dynMsk.

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Figure 7: GPS L1 OMC for selected baselines in Bad Frankenhausen w/ applying dynMsk at both sites, (a-c) baselines SL03-GP1, (b) baselines SL03-GR2. Light grey dots show DD OMC obtained by dynMsk, black dots show observables, erased by dynMsk.

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Figure 8: GPS L1 OMC for selected baselines in Bad Frankenhausen w/ applying dynMsk at both sites, (a-c) baselines SL03-GP1, (b) baselines SL03-GR2. Light grey dots show DD OMC obtained by dynMsk, black dots show observables, erased by dynMsk.

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Figure 9: GPS L1 OMC for selected baselines in Bad Frankenhausen w/ applying dynMsk at both sites, (a-c) baselines SL03-GP1, (b) baselines SL03-GR2. Light grey dots show DD OMC obtained by dynMsk, black dots show observables, erased by dynMsk.

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Figure 10: GPS L1 OMC for selected baselines in Bad Frankenhausen w/ applying dynMsk at both sites, (a-c) baselines SL03-GP1, (b) baselines SL03-GR2. Light grey dots show DD OMC obtained by dynMsk, black dots show observables, erased by dynMsk.