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Subject Area	Sensor, Actuator and Communication Systems
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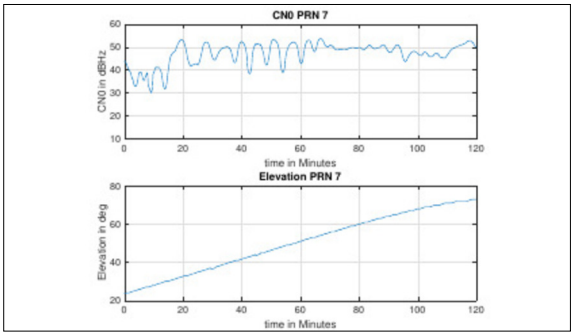
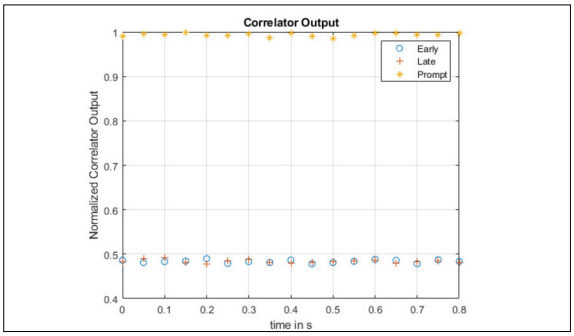
GNSS Multipath Mitigation Using Antenna Arrays



Measurements showing fluctuation in carrier-to-noise ratio, due to multipath signals.
Own presentment

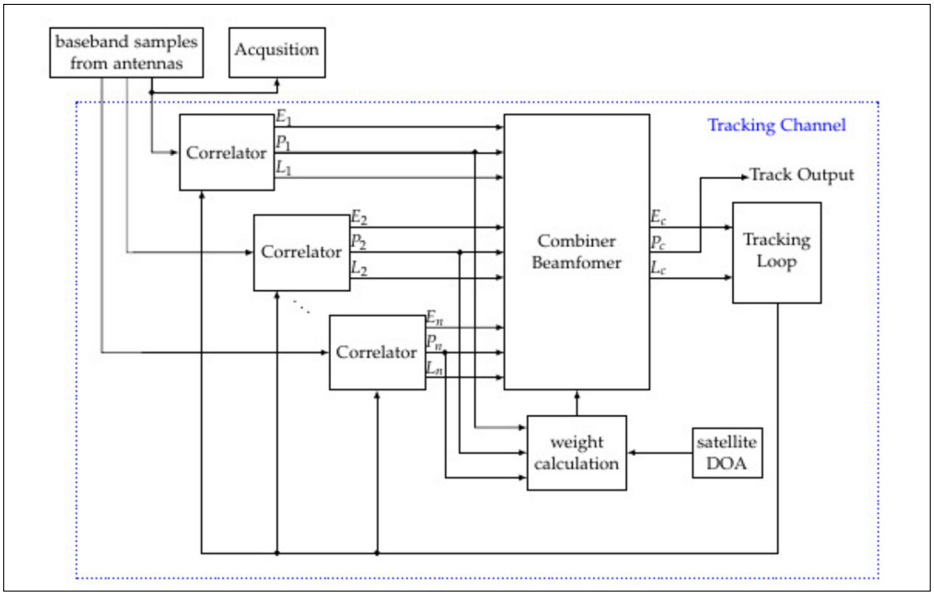


Correlator output of the simulated beamformer shows a stable correlator, even when multipath is present.
Own presentment

Introduction: Global Navigation Satellite Systems are the first choice for a precise navigation solution or time synchronisation. The accuracy of the estimated position has increased in the last decades for example by smarter signal processing or the use of multiple constellations. Nevertheless multipath signals still have an impact on the position accuracy not to be neglected . To reduce the impact of this multipath signals in commercially used products mainly signal processing approaches are used. Approaches using antenna arrays and spatial filtering are nowadays mainly used in military applications or as aresearch topic but showed already promising results.

Approach: This thesis should act as a first step into the direction of understanding the problem of multipath signals better and how they can be mitigated by using antenna arrays. For this purpose a receiver based on MATLAB was adapted have full access to all parameters. First the impact by multipath signals on receivers were investigated by simulations and measurements. Afterwards simulations on the antenna array approach were carried out by implementing a beamforming and multipath simulation environment based on the MATLAB receiver.

Result: A MATLAB receiver was implemented, which works for GPS L1 signals. The impact of multipath signals on the tracking stage could be shown with simulations as well as by measurements. Also the impact to the carrier-to-noise ratio was investigated and it was shown that the impact can be quite big. At last, simulation showed that the impact by multipath on the tracking can be reduced significantly by using antenna arrays and digital beamforming algorithms. The correlator output of the tracking stage is stable, even when multipath is present.



Tracking-stage structure of one tracking channel with digital beamforming.
Own presentment