Modified High Resolution Correlator Scheme for Improving the Performance of Short Delay Multipath Mitigation

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ABSTRACT
Multipath is one of the main error sources in global navigation satellite system (GNSS) positioning. The high-resolution correlator (HRC) is one of the most powerful multipath mitigation techniques in the non-parametric approach well known for its outstanding performance for mid-delayed multipath-induced error mitigation. And recent studies of multipath performance of upcoming signals reported that HRC showed extraordinary performance on both GPS and Galileo signal candidates. But it still has a remaining error for the short-delayed multipaths. This paper proposes a modified HRC scheme that improves multipath mitigation performance of short-delayed ones by removing or reducing the error. The new method estimates the tracking error of conventional HRC, and the estimate is utilized to augment the HRC discriminator in order to eliminate the remaining tracking error. The estimation process is performed by geometric analysis of the distorted auto-correlation function (ACF) by short-delayed multipath. A simulation was performed for GPS C/A code signals with two-path signal model. The resulted multipath error envelope shows short-delayed multipath-induced errors by about one third of the conventional HRC. And the method was also implemented with a software receiver, and the experimental tests verified the simulation results. Despite its outstanding performance for short-delayed multipath and compatible performance to conventional HRC for the mid-delayed multipath, the modified HRC is simpler and easier to implement. It could be a useful approach to cope with short and mid-delayed multipath

COVENTIONAL METHODS
Figure 1 shows simulated multipath error envelopes of general EML, Narrow Correlator and HRC. HRC shows similar mitigation performance to the narrow correlator for short-delayed multipath, but for mid-delayed multipath, it perfectly removes the multipath-induced error. But it still has a remaining error for the short-delayed multipath.

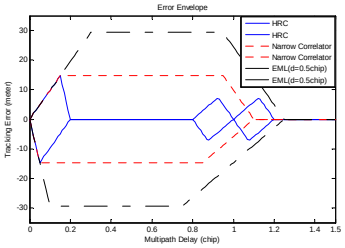

Figure 1. Multipath error envelopes

MODIFIED HRC
The modified HRC estimates the multipath-induced error for short-delayed one, and then augment conventional HRC with the estimate. Figure 2 shows the simulated multipath error envelope. The modified HRC removes or reduces the error by about one third of the conventional one. And the method was implemented with a software receiver verifying the simulation results as shown in Figure 3 representing tracking result of short-delayed multipath signal.

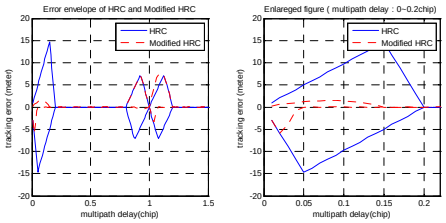

Figure 2. Modified HRC error envelope

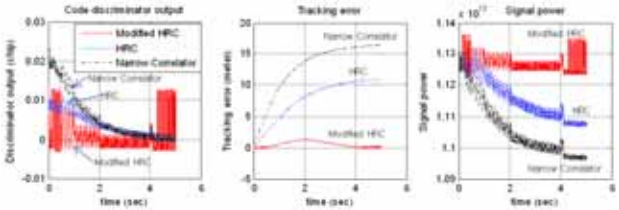

Figure 3. Software receiver implementation