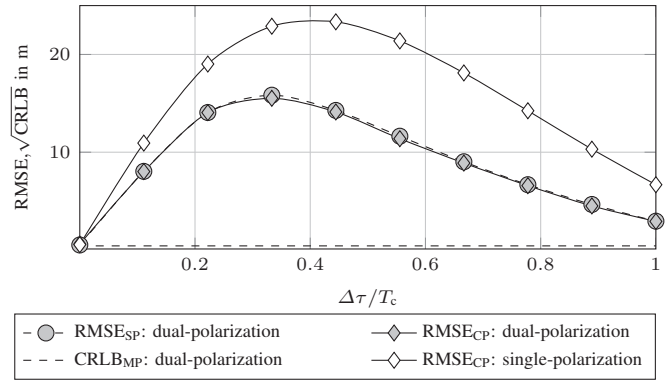

Figure 4. Performance in dependency of the delay difference $\Delta\tau$

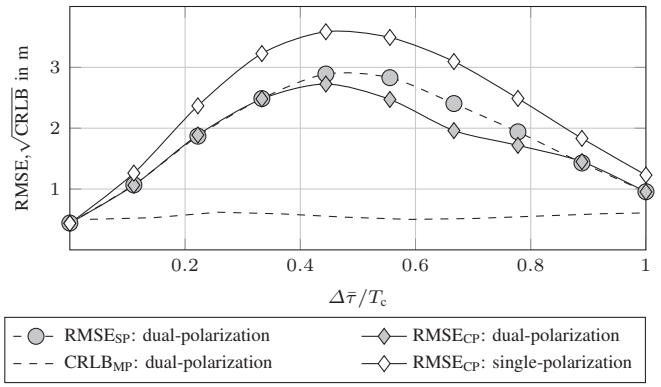

Figure 5. Performance in dependence of the mean delay difference $\Delta\bar{\tau}$

B. Delay Difference Dependency

Figure 4 shows the RMSE and CRLB for the estimate of τ_0 for different delay differences $\Delta\tau$ for the case of one multipath signal with $\phi_1 = 72°$ and $\theta_1 = -84°$, i.e. where the LOS and multipath are highly spatially correlated. Again, dual polarization estimation is in general beneficial for the estimation of τ_0. Estimation with the CP model has a slightly better performance than estimation with the SP model in the case of $\Delta\tau \approx 0.5\,T_c$.

Figure 5 shows the RMSE and CRLB of the estimate $\hat{\tau}_0$ for $L = 6$ multipath signals over the mean delay difference $\Delta\bar{\tau} = \frac{1}{L}\sum_{l=1}^{L}\tau_l - \tau_0$. For the multipath delays $\tau_l - \tau_{l+1} = 0.01\,T_c\,\forall\,l$ holds. The mulitpath azimuth AoAs are $\phi_1 = 72°$ while the elevation AoAs θ_l are approximately $90°$ or $-90°$. Therefore, the LOS and multipath are highly spatially correlated. In this scenario dual-polarization in general has better performance than single-polarization estimation. Especially for $\Delta\bar{\tau} \approx 0.5\,T_c$ the CP model outperforms the SP model.

VI. Conclusion

We have assessed the problem of multipath mitigation with dual polarization estimation. We have introduced a dual polarization multipath model which comprises polarized wave propagation effects and dual polarization receive array properties. In order to reduce the number of model parameters for dual polarization signal processing, the CP model was introduced. The CP model describes the temporal correlation between the LOS and multipath signal and can efficiently be estimated in a two-step approach. We have shown that dual polarization estimation can outperform single polarization estimation in GNSS scenarios. Especially in cases where LOS and multipath signal are highly spatially correlated, dual polarization estimation can add an additional degree of freedom which allows one to separate the LOS from the multipath signal. In the case of several multipath signals the CP model achieves a higher estimation performance than the SP model. In order to get closer to the multipath CRLB, an estimation of the full multipath model can be performed. However, in this case different problems arise. As in single-polarization scenarios, the model order has to be estimated and the LOS delay has to be determined from all estimated delays. Due to the dual-polarization model, the reflection coefficients of every multipath also have to be estimated, an issue that is avoided with the CP model. Due to these problems a real multipath estimator will also not always achieve the multipath CRLB.

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