Fig. 3: Prediction performance of GP models: RMSE of the prediction for each state.

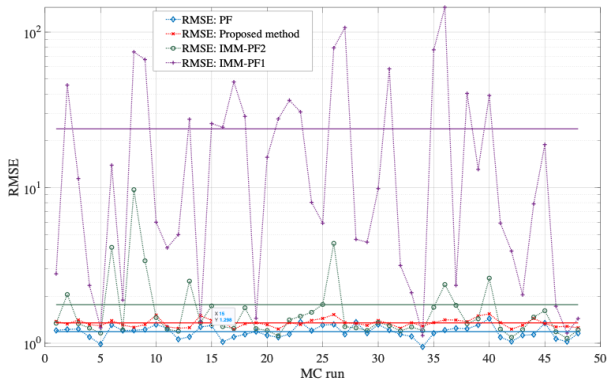

Fig. 4: Comparison of RMSE tracking performance achieved by different methods, and the straight lines show the mean value of the RMSE.

denoted as $\{\mathrm{CV}, \mathrm{CT}_{\omega=\omega^{(1)}}, \ldots, CT_{\omega=\omega^{(\Upsilon)}}\}$, where Υ is the number of the equal intervals that the cumulative distribution function (CDF) of ω is divided into. The comparisons of tracking performance achieved by the proposed GP-PF based method with others are shown in Fig. 4 and Fig. 5. In Fig. 4, $r = 1$, RMSE performance comparison is evaluated by different Monte Carlo realisations, i.e., different random target trajectories. In Fig. 5, RMSE performance with different measurement process noise variance is evaluated, where $r = \{0.1, 1, 2, 5, 10, 20\}$. From these two figures, we see that the proposed method outperforms the IMM-PF methods. Furthermore, the proposed method shows better robustness for different random trajectories of the target. Compared with the traditional PF with full information, the performance of GP-PF is very good considering it has no prior knowledge of the turn rate.

V. Conclusion

In this study, we propose a new method for single target tracking for mixed and uncertain motion. The proposed method is based on Gaussian process regression. The experiments show that this method has clear advantages to IMM methods when dealing with model uncertainty, and shows great robustness for random target trajectories and

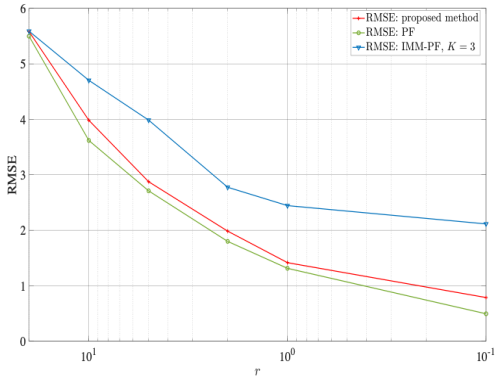

Fig. 5: RMSE tracking performance comparison within various measurement noise density, averaged over 100 Monte Carlo realisations.

system parameters. Further work will explore the proposed filter's performance on real world data and the performance when dealing with the multi-target tracking problem.

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