Using the Innovations of Extended Kalman Filter in Traffic

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Abstract: In majority of cities, the current structure of the urban road network is not sufficient for that heavy traffic. The weak places are the crossroads because they decrease the capacity of road. For the increase of capacity of crossroads, an algorithm was made the algorithm and was described as state-space model for traffic control [1, 2].

The traffic model is non-linear. It contains the non-linear relation between occupancy and queue length and maybe the other relation can be non-linear. We can not use the Kalman filter in case too, when we do not know the input values as intensity, occupancy etc.

Hence, the standard Kalman filter is not suitable and we have to use innovations of extended Kalman filter (EKF) [3]. The EKF is not suitable for this model because it transform stable nonlinear relation into unstable linear relations.

This problem some of the EKF's innovations solve. It seems that the suitable filters are the DD1, DD2 and unscented Kalman filter. The DD1 and DD2 filter are based on Taylor approximation. The main difference between DD1 (DD2) filter and EKF is in replacement the Jacobians by divided differences [4].

The Unscented Kalman Filter (UKF) solves problem with transform nonlinear to linear relation using deterministic sampling approach [5].

References

[1] J. Kratochvílová and I. Nagy, "Traffic control of microregion.," in *CMP'04: MULTIPLE PARTICIPANT DECISION MAKING, Theory, algorithms, software and applications*, J. Andrýsek, M. Kárný, and J. Kracík, Eds., pp. 161 – 171, Adelaide, May 2004a. Advanced Knowledge International.

[2] J. Kratochvílová and I. Nagy, "Lokální řízení městské dopravy.," Tech. Rep. 2101, ÚTIA AV ČR, Praha, 2004b.

[3] G. Welch and G. Bishop, "An introduction to the kalman filter," Tech. Rep. TR 95-041, Department of Computer Science, DTU, Chapel Hill, NC 27599-3175, 2004.

[4] M. Norgaard, N. Poulsen, and O. Ravn, "Advances in derivative-free state estimation for nonlinear system," Tech. Rep. IMM-REP-1998-15, Department of Mathematical Modelling, UNC, 2800 Lyngby, Denmark, 1998.

[5] E. Wan and R. van der Merwe, "The unscented kalman filter for nonlinear estimation," in *Proc. of IEEE Symposium 2000 (AS-SPCC)*.