















process noise variance of channel model, the risk sensitive filter is robust as compared to Kalman filter. Performance of channel estimation obtained by risk sensitive filter and Kalman filter were compared with theoretical performance bound using Cramer-Rao lower bound (CRLB) and the performance obtained by RSF try to follow CRLB, whereas the performance obtained by KF is does not. When channel loosing slow fading nature. i.e  $\Delta$  value is very near to zero, the risk sensitive filter can be effectively used as robust channel estimation.

Thus the proposed work may be an alternative and an efficient method to estimate the time varying channel for modern OFDM and MIMO-OFDM considering more uncertainty in parameter and process noise to improve the bit error rate and mean square error for better performance.

#### References

- [1] Steven M.Key, *Fundamental of Statistical Signal Processing: Estimation Theory*, pages: 452-456, Prentice Hall, NJ 1993.
- [2] Rene K. Boel, Matthew R. James, Ian R. Peterson, "Robustness and risk sensitive filtering," *IEEE Transactions on Automatic Control*, vol.47, No.3, pp: 451-461, March 2002.
- [3] Ali Jamoos, Ahmad Abdo, Hanna Abdel Nour, Eric Grive, "Two Cross-Coupled  $H_\infty$  Filters for Fading Channel Estimation in OFDM Systems" *Novel Algorithms and Techniques in Telecommunications and Networking*, pp 349-353, Springer, Netherlands, 2010
- [4] Xuewu Dai, Wuxiong Zhang, Jing Xu, John E Mitchell and Yang Yang, "Kalman interpolation filter for channel estimation of LTE downlink in high-mobility environments," *EURASIP Journal on Wireless Communications and Networking*, 2012.
- [5] Bor-Sen Chen, Chang-Yi Yang, and Wei-Ji Liao, "Robust Fast Time-Varying Multipath Fading Channel Estimation and Equalization for MIMO-OFDM Systems via a Fuzzy Method," *IEEE Transactions on Vehicular Technology*, Vol. 61, No. 4, May 2012.
- [6] Kareem E. Baddour, Norman C. Beaulieu, Autoregressive Model for Fading Channel Simulation, *IEEE Global Telecommunication Conference*, vol.2 pp:1187-1192, 2001
- [7] Shervin Howard, Christian Schlegel, "Differentially-encoded Turbo coded Modulation with APP Channel Estimation," *IEEE Global Telecommunication Conference*, vol.3, pp: 1761-1765, Dec.2003.
- [8] Ahmad R. S. Bahai, Burton R. Saltzberg, Mustafa Ergen, *Multicarrier Digital Communications: theory and application of OFDM*, Springer, Second Edition, 2004
- [9] U.Urguner, F. Gustafsson, "Risk sensitive particle filter for mitigating sample impoverishment," *IEEE Transactions on signal processing*, Vol.56, issue 10, 2008
- [10] Jiyan Huang, Qun Wan, "CRLB for DOA Estimation in Guassian and Non-Gaussian Mixed Environment," *Journal of wireless Personal Communications*, Vol 68, issue 4, pp: 1973-1688, Feb 2013.
- [11] Fan Wang, Venkataramanan Balakrishnan, Robust Steady-State Filtering for Systems With Deterministic and Stochastic Uncertainties," *IEEE Trans. On Signal Processing*, Vol. 51, No. 10, October 2003.
- [12] Jun Cai, Xuemin Shen, Jon W. Mark, "Robust Channel Estimation for OFDM Wireless Communication Systems—An  $H_\infty$  Approach", *IEEE Trans. on Wireless Communication*, Vol. 3, No. 6, Nov 2004.
- [13] Huseyin Arslan, Sharath Reddy, Noise Power and SNR Estimation for OFDM Based Wireless Communication Systems,
- [14] Sinem Coleri, Mustafa Ergen, Anuj Puri, and Ahmad Bahai, "Channel Estimation Techniques Based on Pilot Arrangement in OFDM Systems," *IEEE Trans. on Broadcasting*, Vol.48, No.3, Sept 2002.
- [15] Pei Xiao, Erik Strom, Rolando Carrasco, "Estimation of Time-Varying Multipath Rayleigh Fading Channels in Asynchronous DS-CDMA Systems," *15th IEEE International Symposium on Indoor and Mobile Radio Communications*, Volume: 4PIMRC, 2004.
- [16] Rohit Negi, John Cioffi, "Pilot Tone Selection for Channel Estimation in a Mobile OFDM Systems," *IEEE Transactions on Consumer Electronics*, Vol.44, No.3, Aug 1998.
- [17] Michel C. Jeruchim, Philip Balaban, K. Sam Shanmugan, "Simulation of Communication Systems: Modeling, Methodology, and Techniques," 2<sup>nd</sup> edition, Springer Kluwer Academic publisher, 2002.
- [18] Alper T. Erdogan, Babak Hassibi, Thomas Kailath, "on  $H_\infty$  equalization of communication channels", *IEEE transactions on signal Processing*, Vol.48, No.11, Nov 2000.



