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Optimisation of Lane Tracking using Hybrid Kalman and Particle Filter Algorithm

Manisha Lande
Department of Electronics (Communication) Engineering
Nagpur, India

Abstract— Abstract-In this research, we introduce "Optimization of Lane Tracking by Using Hybrid kalman and Particle filter" .Presented approach gives us idea about perfect and efficient tracking. Model is designed to provide real time tracking. This approach further introduces the lane detection by using Hough Transform before tracking to get near ideal model. Improvement in lane tracking have been increased and measured extensively. Model is developed on Matlab/Simulink. The developed model was tested on various weather condition during different time. The whole model is developed for the assistance of driver in rainy, sunlight foggy condition. This model is helpful and gives near real situation of road by tracking using kalman and particle filter. They help in providing robustness to complex shadowing, lighting changes from overpasses and tunnels, and road-surface variations. Use of digitised camera on dashboard of vehicle and warning system is also done in this model in order to warn driver about the bad situation of road for their safety .This model overcomes all the problem that occured in previous tracking system in different time and weather conditions.

Keywords—*Computer Vision,Lane Tracking,Driver Assistance,Matlab/Simulink,Intelligent Vehicle*

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I. INTRODUCTION

Currently many work has been done on lane tracking by using various sensors,GPS etc. Navigation filters are also use for this purpose. Previously work on Kalman filter is also done but kalman filter algorithm is not suitable for nonlinear model or road having curvatures. This gives false tracking on rural roads.The motivation behind this model is to assist driver at different time in different condition. The important task of the model is to get exact and efficient tracked lane while driving. This model is based on hybrid of two filters i.e navigation filter. As particle filter is nonlinear while kalman filter is linear, the model will definitely work well in both linear and nonlinear condition. This model gives safety measures of on-going road which will gives idea about the situation of road or curvatures that road have.

The system can be make real-time by putting camera(CCD) on the dashboard or front of vehicle to capture images of road continuously .Image processing is applied on this taken images in order to detect lane. Tracking algorithm can be applied to applied on both detected and non detected lane but detected lane makes clear visualization of tracked lane. Marking of lanes are detected and is used in kalman filter measurement. Design of kalman filter is suitable only for highway not on rural road. In kalman filtering sometimes incorrect prediction can be made due to the different or bad road condition.To overcome this situation particle filter is used.This filter is suitable in different scenarios.

We combined Kalman and particle filter to combat the problem of some local limitations of kalman filter and the variance choices in particle filter.Kalman filter propogates and update mean and covariance of distribution but in non-linear system or in non Guassian system it is vert difficult to find distribution.The effectiveness and the performance of system is analysed and tested on road in different condition.This system is able to give position of curvature of road.System is beneficial for long distance buses where safety is critical and essential issue.The vision based comuter tool is used to handle this project.Alarm is generated if there is some obstacles in lane or situatin which is not convenient.

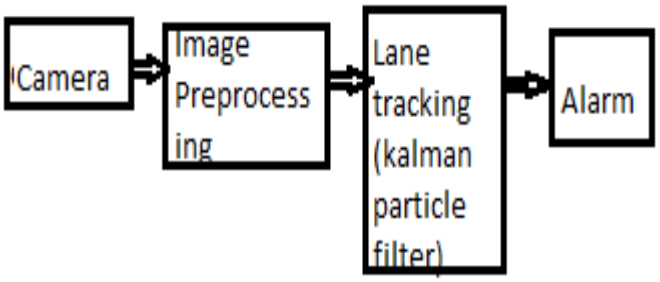


fig 1.Block diagram of proposed lane tracking

II. ALGORITHMS

Lane recognition is based on two navigation filter i.e kalman filter and particle filter.Kalman filter gives the scenario between previous and current situation while particle filter gives scenario of each changing particle and image recognition of lane.In order to make model work in linear and non linear condition ,hybrid of filter is used.Model is designed to exploit the advantages of both kalman and particle filter.

Rural road scenario can also be tracked by this hybrid model in different weather condition at different time.

A. Tracking by Kalman Filter

State vector of system and its error covarience matrix can be obtained by kalman filter.Filtering in kalman can be done by two step. See fig.2,it predicts state vector and error covariance matrix P then it correct the predicted state vector by appropriate measures.Error covarience matrix is also corrected.Assumption made in kalman filter is to predict the state and correct the state are very close to each other.The filter which is used in the tracking and recognition expects continuosly changing road.The state parameter changes abruptly because of curvature variations.This error are small at highways but the error are more on rural road due to the

variation instate parameter which creates problem in lane tracking.Incorrect prediction occurs which gives false tracking.It does not provide cooperation with multiple measurements.

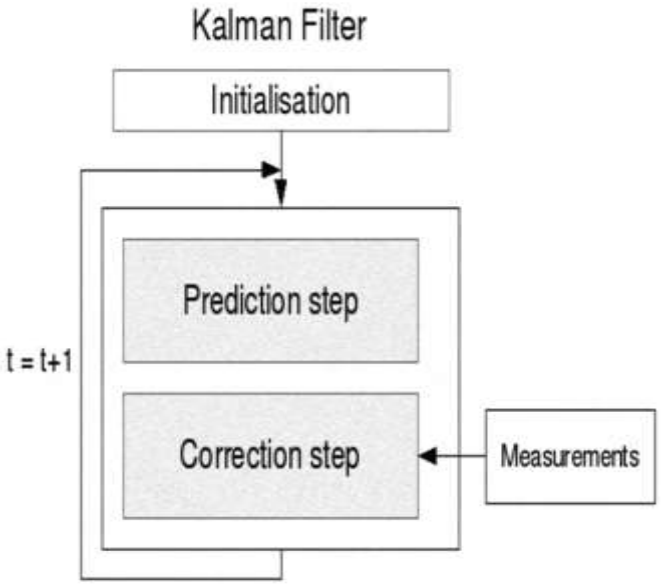


Fig.2 Kalman filter with two step i.e prediction and correction

B.Tracking by Particle Filter

Condensation algorithm is widely used variant of particle filter.The algorithm is given in fig.3.At very first step i.e prediction step,each and every particle is predicted into current time instant.Particle are weighted in the weighting step using the factor F with calculated likehood P(F(x,y)/s) upto normalization factor

At the process of selecting number of particle are multiplied depending on the weight and some noise i.e Gaussian noise is added to each particle.Particle filter is totally depend on variance.This is the drawback of particle filter in the application of recognition.

Step 1. For i=1,…N draw new particles x^i_k from the prior density$\prod(x_k/x^i_{k-1})$ and then use likelihood density to calculate the correspondent weight $w^i_k=\prod(z_k/x^i_k)$.

Step 2. Calculate the total weight $\mathbf{T_w}=\sum^N W^i_k$ and then normalize the particle weights,that is for i=1,…N
let $w^i_k=T^{-1}_w w^i_k$.

Step 3. Resample the particle as follows:

Step 3.1: Construct the cumulative sum of weights(CSW) by computing $c_i=c_{i-1}+w^i_k$ for i=1,…N with $c_0=0$.

Step 3.2:Let i=1 and draw the straight point $u_i$from the uniform distribution $U(0,N^{-1})$

Step 3.3: For j=1,…N
1.Move along the CSW by making $u_i=u_i+N^{-1}(j-1)$
2.While $u_i>c_i$ make i= i+1.
3.Assign samples $x^i_k=x^j_k$.

4.Assign weights $w^i_k=N^{-1}$

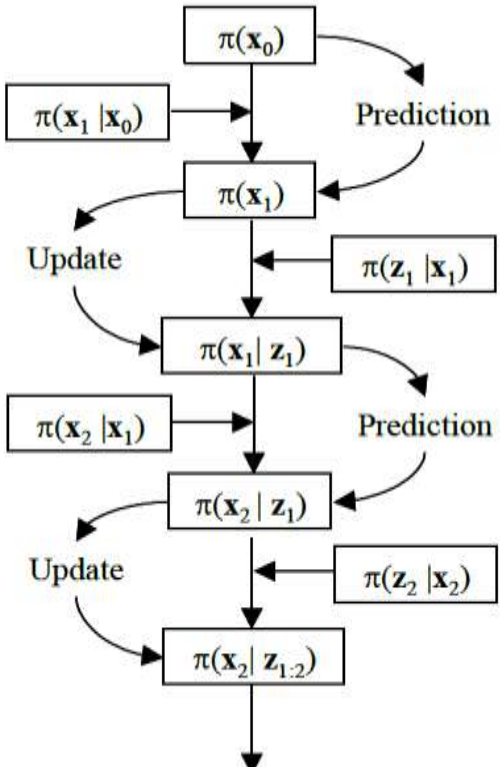


Fig.3 Prediction and update state of kalman filter

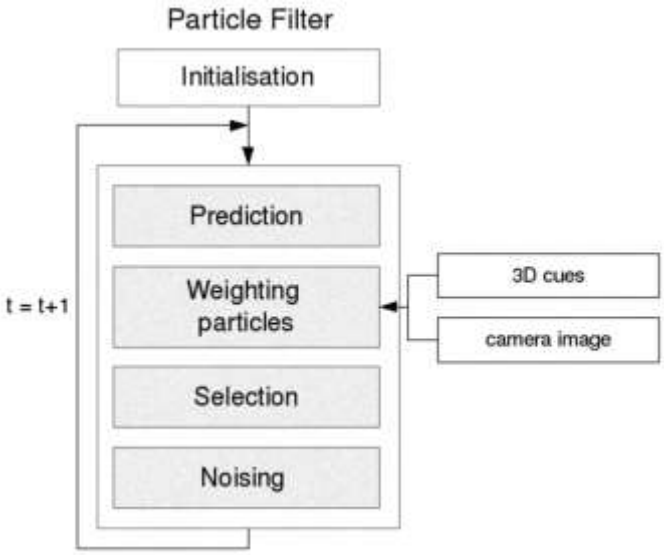


Fig 4.Particle filter with prediction and selection step

III. TRACKING BY PARTICLE AND KALMAN FILTER

Advantages of both kalman and particle filters are taken into account in this resaerch.Particle filter takes control of multiple hypothesis and also take into account weak cues of the road like colour and texture.In opposition to this,kalman filter does implicit calculation of the error covariance matrix of estimated state vector and correction of the predicted state by

measurement.This two filters are combined to help each other and eliminates or to reduce the drawback of each other.In fig 5.Prediction step of the particle filter is substituted by acomplete kalman filter step where every single particle is corrected after prediction and its covariance matrix is calculated.The vectors are corrected and then weighted by different cues.State vectors of each particle shows lane hypothesis and also covariance matrix.Therefore kalman particle filter can be used as multi hypotheses. Since the state vectors are corrected in the Kalman Filter step and the variances are automatically adjusted, the number of particles can be reduced.The different sources of information Fi are conditionally independent which leads to the joint probability

$$P(F_1 \ldots F_n/s^-)=\prod p_i(F_i/s^-)$$

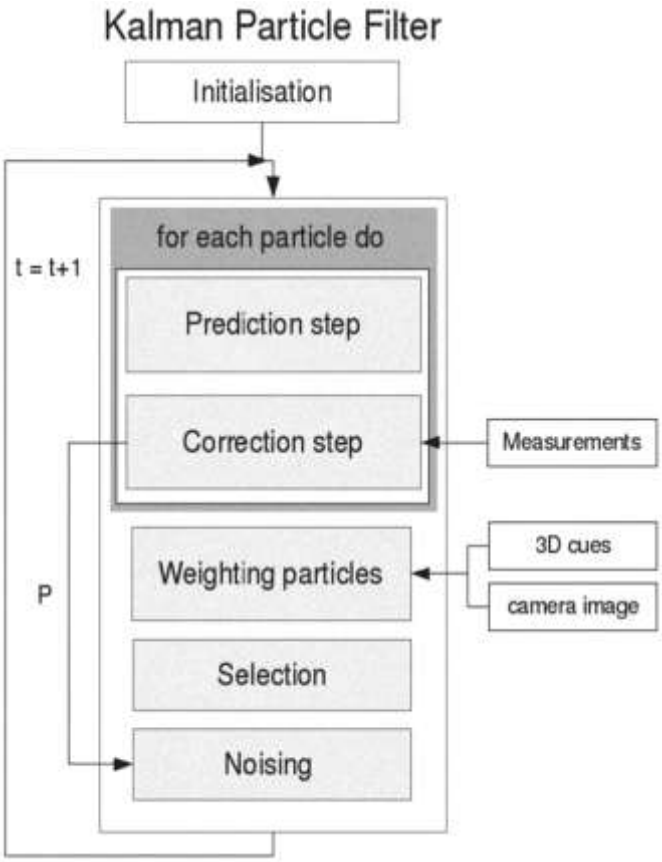


Fig 5. Hybrid kalman particle filter

IV. EXPERIMENTS

Camera (CCD) is used to take picture of road continuously.Taken images is then given to mobile computer through IEEE interface.The camera which is mounted on dashboard will continuously take pictures of road.

It is very important to extract the features of road i.e region of intrest by the lane detection.After this,we will apply sampling that is the process of tracking.When there is a situation of high contrast, the verticle edge become blurr but this tracking strategy track a lane properly even when the features of lane is not clear.

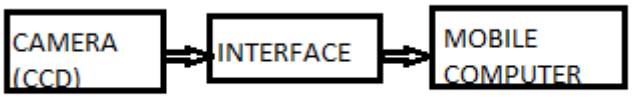


Fig 6. Image processing for detection of lane by usint IEEE interface

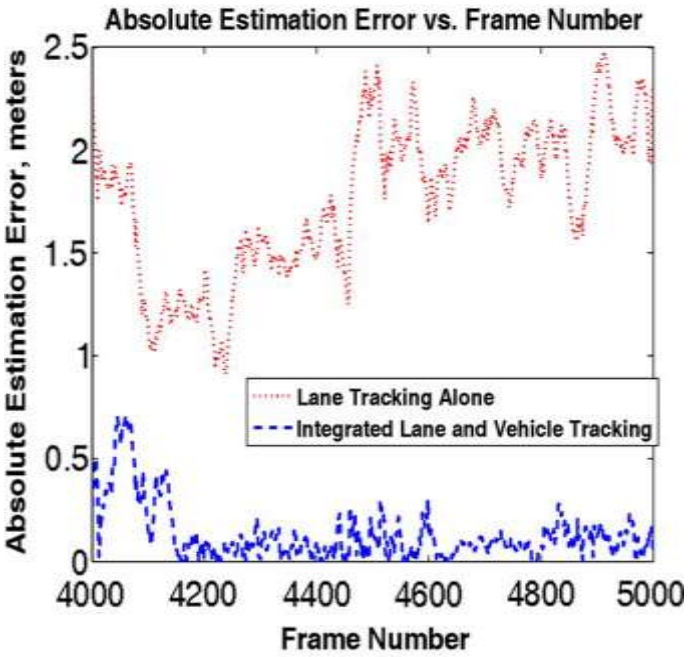
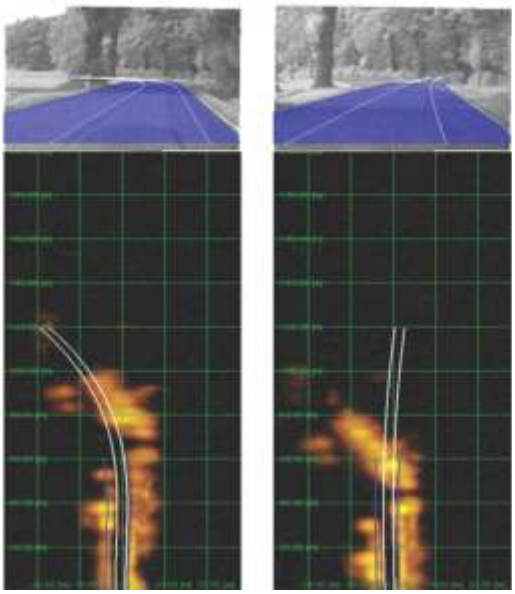


Fig 7. Right lane marker estimation error

Fig 8. Lanr tracking in dense traffic by dsing kalman and particle filter



Frame 94 Frame 124

Fig 9.estimated corse of lane by particle filter

V. CONCLUSION

In this paper ,we tried to merge algorithm of two navigation filter i,e kalman filter and particle filter. videos are taken to validate the effectiveness of our system even under some difficult environment and various lighting conditions. And, the frame rate of our proposed system is roughly 20 fps and it is ready for real-time application.However, in some cases, the detection results are unsatisfactorily.Further future extenstion can be given to the model in order to overcome all environment and lighting condition.

VI. REFERENCES

[1] E.D. Dickmanns, A. Zapp, *A Curvature-Based Scheme for Improving Road Vehicle Guidance by Computer Vision*, SPIE, vol. 727, pp. 161168,1986.

[2] B. Southall, C.J. Taylor. *Stochastic Road Shape Estimation.* In *ICCV01*,2001, pp. 205-212.

[3] N. Apostoloff, A. Zelinsky. *Robust vision based lane tracking usingmultiple cues and particle filtering.* In *Proceedings of IEEE Intelligent Vehicles Symposium, 2003.*

[4] P. Smuda, R. Schweiger, H. Neumann, W. Ritter, *Multiple Cue Data Fusion with Particle Filters for Road Course Detection in Vision Systems.*In *Proceedings of IEEE Intelligent Vehicles Symposium, 2006.*

[5] U. Franke, H. Loose, C. Knappel, *Lane Recognition on Country Roads.* In *Proceedings of IEEE Intelligent Vehicles Symposium*, 2007.

[6] R. Danescu, S. Nedevschi, M.-M. Meinecke, T.-B. To. *A StereovisionBased Probabilistic Lane Tracker for Difficult Road Scenarios.* In *Proceedings of IEEE Intelligent Vehicles Symposium, 2008.*

[7] U. Meis, R. Schneider, *Radar image acquisition and interpretation for automotive applications.* In *IEEE Intelligent Vehicles Symposium, 2003*, pp. 328-332.

[8] M. Serfling, R. Schweiger, W. Ritter. *Road course estimation in a night vision application using a digital map, a camera sensor and a prototypical imaging radar system.* In *Proceedings of IEEE Intelligent Vehicles Symposium*, 2007.

[9] G. Welch and G. Bishop, *An introduction to the Kalman filter*. Technical report, University of North Carolina at Chapel Hill, Chapel Hill, NC, USA, 1995.

[10] M. Isard, A. Blake, *CONDENSATION - conditional density propagation for visual tracking.* International Journal of Computer Vision, vol. 29, nr.1, pp. 5-28, 1998.

[11] R. van der Merwe, A. Doucet, N. de Freitas, E. Wan. *The Unscented Particle Filter.* In *num. CUED/F-INFENGITR 380, Cambridge University Engineering Department, 2000.*

[12] H. Badino, U. Franke, R. Mester. *Free Space Computation Using Stochastic Occupancy Grids and Dynamic Programming.* In *Workshop on Dynamical Vision @ ICCV, 2007.*

[13] A. Wedel, U. Franke, H. Badino, D. Cremers. *B-Spline Modeling of Road Surfaces for Freespace Estimation.* In *Proceedings of IEEE Intelligent Vehicles Symposium, 2008.*

[14] S. Nedevschi, R. Schmidt, T. Graf, R. Danescu, D. Frentiu, T. Marita, F. Oniga, C. Pocol. *3D Lane Detection System Based on Stereovision.* In *Proceedings of IEEE Intelligent Transportation Systems Conference*,2004.

[15] H. Hirschmiiller. *Accurate and Efficient Stereo Processing by SemiGlobalcMatching and Mutual Information.* CVPR 2005, PAMI 30(2):328341,2008.

[16]] S. K. Gehrig, U. Franke. *Improving Stereo Sub-Pixel Accuracy for Long*