

Abstract

A STATE VECTOR AUGMENTATION METHOD FOR INCLUDING VELOCITY INFORMATION IN THE LIKELIHOOD FUNCTION OF THE SIR VIDEO TARGET TRACKING FILTER

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This thesis is focused on visual target tracking. Visual target tracking has been widely studied. The main idea is to be able to determine the target's location from a video sequence. Techniques such as the Kalman Filter and its variations have been proved to be the optimal solution when the system is linear or can be linearized, and Gaussianity can be assumed. But these conditions often do not hold in real world applications. Therefore, an alternative approach based on Sequential Monte-Carlo methods, also known as the Particle Filter, arose among others and has become a popular technique for target tracking recently. The particle filter is able to estimate the target state under nonlinear, non-Gaussian conditions. Different types of particle filters have been developed over the years, but one of the most popular is the sampling importance resampling (SIR) algorithm. However, in conditions of highly structured clutter and occlusion the filter's performance is decreased and the tracker can lock into the background and loose the target. Since motion information has been shown to be very important for the unmanned target

tracking problem, in this thesis I introduce a new method to make the SIR filter more robust against these conditions by indirectly including velocity information in the likelihood function of the SIR filter. I propose augmenting the SIR filter state vector in order to use particle velocity information to prevent particles with poor motion estimates from obtaining large weights. The main original contributions of this thesis include the following:

- I developed the theoretical formulation for the State Vector Augmented SIR filter algorithm.
- I reformulated the normalized cross correlation used in the Likelihood function of the SIR filter to include the velocity information in it.
- I developed an algorithm to generate synthetic data sequences with targets that can change both in magnification and rotation for testing the efficacy of tracking algorithms in a controlled environment.
- I developed a simple template update strategy to deal with target appearance changes.
- I prove the effectiveness of the proposed algorithm with tracking results obtained from two longwave infrared sequences and two synthetic data sequences.

The results show that this new method can improve tracking performance for moving targets immersed in strong structured clutter.