Using Kalman filter in the frequency domain for multi-frame scalable super resolution

Akbar Rahimi , Payman Moallem , Kamal Shahtalebi , Mehdi Momeni

PII: S0165-1684(18)30296-2
DOI: https://doi.org/10.1016/j.sigpro.2018.09.012
Reference: SIGPRO 6922

To appear in: *Signal Processing*

Received date: 14 August 2018
Accepted date: 8 September 2018

Please cite this article as: Akbar Rahimi , Payman Moallem , Kamal Shahtalebi , Mehdi Momeni , Using Kalman filter in the frequency domain for multi-frame scalable super resolution, *Signal Processing* (2018), doi: https://doi.org/10.1016/j.sigpro.2018.09.012

Using Kalman filter in the frequency domain for multi-frame scalable super resolution

Akbar Rahimi[1], Payman Moallem[1*], Kamal Shahtalebi[1], Mehdi Momeni[2]

1- Department of Electrical Engineering, Faculty of Engineering, University of Isfahan, Isfahan, Iran

2- Department of Surveying Engineering, Faculty of Engineering, University of Isfahan, Isfahan, Iran

*Corresponding Author

Abstract: Kalman filter (KF) as a linear estimator which is used in super-resolution (SR) problems, suffers from high computational costs and storage requirements. To gain appreciable success in the elimination of these two challenges, this paper advances a SR framework employing KF in the frequency domain, while no resort is made to any approximations or extra assumptions in the dynamic system modeling and statistical matrices. Generally, previous KF-based SR methods organized the system with huge-sized matrices in the spatial domain, following which they tried to reduce the system dimension using approximation and/or limitation on point spread function (PSF). In this study, first, several small-dimension dynamic systems are separately made in the frequency domain supporting space-invariant PSFs of an arbitrary form and size. Then, the acquired small-dimension KF estimators are applied rather than the traditional huge-dimension one. These will greatly reduce computational complexity, decrease storage requirements allowing parallel implementation as well. Furthermore, our proposed SR framework can be used to produce high resolution image of an expedient size, that is, a scalable SR. Experimental results with both simulated and real world sequences indicate that our proposed framework works more effectively than the other compared methods, especially in fine details restoration.

Keywords: Super-resolution, Kalman filter, frequency domain