# Improving NDVI Time Series Class Separation using an Extended Kalman Filter

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## I. Abstract

Automated land cover change detection which make use of supervised machine learning methods often require unattainable amounts of training data that are rarely uniformly available at a regional scale. Unsupervised land cover classification and change detection methods therefore present the most practical option. As a first step towards this goal we tested the seperability through time of parameters derived with an Extended Kalman Filter (EKF) of two land cover classes, i.e. natural vegetation and settlements in the Limpopo Province of South Africa. It was proposed that a NDVI time series data calculated from MODIS BRDF-corrected surface reflectance data (MCD43) may be modeled as a cosine function where the amplitude A, instantaneous frequency $\omega$ and the phase $\phi$ are functions of time. This triply modulated cosine function was able to model the time series accurately, but the estimation of the parameters $A^k, \omega^k, \phi^k$ (k is the discrete time index) were difficult, since the problem is non-linear. The nonlinear EKF was then applied and it was found that the parameters of a specific land cover type tended to be correlated over time, while they were less correlated with the parameters of a time series belonging to a different land cover type. Statistical examination suggests that parameters of different land cover types are therefore separable over time. The EKF was adapted by specifying the process and observation noise to maximise the separability of the parameters. Preliminary results indicate that seperability achieved using the method outlined above was superior to similar approach where the conventional Fast Fourier Transform (FFT) components of the same data were used to separate the two classes.