Online transition matrix identification of the state evolution model for the extended Kalman filter in electrical impedance tomography

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The electrical impedance tomography objective is to estimate the electrical resistivity distribution in a domain based only on contour electrical potential measurements caused by an imposed electrical current distribution into the contour. In biomedical applications, the random walk model is frequently used as evolution model and, under this conditions, it is observed poor tracking ability of EKF. An analytically developed evolution model is not feasible at the moment. The present work investigates the possibility of identifying the evolution model in parallel to the EKF and updating the evolution model with certain periodicity. The evolution model is identified using the history of resistivity distribution obtained by a matrix sensitivity based algorithm. To identify the numerical linear evolution model, it is used the Ibrahim Time Domain Method, normally used to identify the transition matrix on structural dynamics. The investigation was performed by numerical simulations of a resistivity time varying domain with added noise to simulate instrumentation and modeling errors. Numerical difficulties to compute the transition matrix were solved using a Tikhonov regularization. The EKF numerical simulations suggest that the tracking ability is significantly improved.