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Robust Adaptive Kalman Filtering based on Qusi-Accurate Detection Method and Plant Noise Variance-Covariance Matrix Tuning

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In this paper, an algorithm was proposed that tunes both the kinematic and measurement noise variance-covariance (VCV) matrices to produce a more robust and adaptive Kalman filter. The proposed algorithm simultaneously considers both observation outliers and abrupt changes. This algorithm may be divided into two basic parts: 1) robust estimation, from which the position components of the filtering estimates and the equivalent weight factor matrix can be obtained; 2) adaptive estimation, from which the adaptive kinematic noise VCV tuning matrix is calculated. And then, all of the predicted states are adaptively updated. An example was used to demonstrate the efficiency of the new algorithm by processing a set of kinematic GPS data received from a rover mounted on an airplane. The processing results are found to be very satisfactory. The observation outliers and abrupt changes are detected and dealt with accordingly. The detailed calculation procedure for the adaptive VCV tuning matrix is also described.