A Sensorless Kalman Estimator toward the Reconstruction of Physiologic Data

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The aim of the 2010 Physionet/ Computers in Cardiology challenge titled Mind the Gap is to robustly reconstruct missing signal from multiparameter physiologic data. Real-time monitoring of physiological signals is an essential method used by clinicians and researchers during sleep studies, surgeries, and intensive care units. However, corruption or loss of some of the signals could occur during monitoring. Such signal corruption could be disruptive especially when signals are required for predicting or monitoring rare events. This work uses a Kalman Filter based approach to estimate the missing signals from concurrently available physiologic signals. The Mind the Gap challenge is divided into two events. The first is to determine the best estimate of the missing signal. The second is to determine the best estimate which correlates with the missing signal. Three sets of data are provided for this challenge: Set-a, Set-b, Set-c consisting of 100 records each. The first two data sets are used for testing, and Set-c will be used toward the final score of both events. The method used in this work estimates the missing signal using measurements from signals occurring simultaneously. The Kalman Filter determines the optimal coefficients which transform concurrent signals to the missing one. The Scoring of the first event is the maximum between 0 or 1 - sum of squares of the error between the estimated signal and original signal normalized by the energy of the residual. The scoring of the second event is defined as the maximum between 0 and the correlation coefficient between the estimated and the actual signal. The final score of each event is the sum of scores across all submitted records. The Kalman filter based estimator approach presented in this work is applied to set-b of the challenge yielding scores of 56.6996 and 70.6656 for events 1 and 2, respectively.