Abstract

A Kalman filtering technique is applied to the simultaneous detection of NH_3 and CO_2 with a diode-laser-based sensor operating at 1.53 μm. This technique is developed for improving the sensitivity and precision of trace gas concentration levels based on direct overtone laser absorption spectroscopy in the presence of various sensor noise sources. Filter performance is demonstrated to be adaptive to real-time noise and data statistics. Additionally, filter operation is successfully performed with dynamic ranges differing by three orders of magnitude. Details of Kalman filter theory applied to the acquired spectroscopic data are discussed. The effectiveness of this technique is evaluated by performing NH_3 and CO_2 concentration measurements and utilizing it to monitor varying ammonia and carbon dioxide levels in a bioreactor for water reprocessing, located at the NASA–Johnson Space Center. Results indicate a sensitivity enhancement of six times, in terms of improved minimum detectable absorption by the gas sensor.

Citation

“Applications of Kalman filtering to real-time trace gas concentration measurements,” with D.P. Leleux, F.K. Tittel, et. al., Optical Society of America Annual Meeting, Long Beach, CA, October 2001.