Modeling the Orion Air Monitor

David E. Burchfield, Ph.D., Wai-Tak Lee, Ph.D., Andrew N. Pargellis, Ph.D.
Hamilton Sundstrand

This paper presents the development of a dynamic system model that describes the performance of a sensor-class mass spectrometer used in air monitoring applications. The instrument, currently the basis for the International Space Station's Major Constituent Analyzer and the Orion Crew Exploration Vehicle Air Monitor, is a single-focusing magnetic sector, focal plane mass spectrometer, capable of monitoring species from hydrogen (H_2, m/z 2) through carbon dioxide (CO_2, m/z 44), simultaneously, using dedicated Faraday collectors. This class of instrument is similar to the dual sector analyzers that are currently used to monitor air for contaminants on nuclear submarines, and the double-focusing analyzer previously flown to Mars as part of the Viking Lander program, but is here optimized for NASA crew safety applications. Specific applications of the dynamic model to optimizing instrument resolution, system response time to water vapor, and automating the tuning of the analyzer are discussed for the Orion sensor and related dynamic environment implementations.