JPL-Electronic Nose for Air Quality Monitoring
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Among the goals of the Life Support and Habitation Program (LSH) is to provide new technologies that contribute to the next generation of human life support systems required for the exploration of space and to improve the habitability of future spacecraft. Development of an electronic nose (ENose) at JPL responds to the AEMC need to provide technology for reducing crew and equipment risk that is comparable to or better than currently available technology. On the ISS the main constituents of air, N₂, O₂, CO₂, H₂O, H₂, CH₄, and CO, are monitored on a “near continuous” basis. The 24-hour Spacecraft Maximum Allowable Concentration (SMAC) is the level of concern between complete air analyses, as 24 hours is the most frequent that full analysis is required. The JPL ENose is designed to monitor for changes between full analyses and is an instrument capable of filling the gap between an alarm, such as a smoke alarm, and an analytical instrument such as a Gas Chromatograph – Mass Spectrometer (GC-MS). A capability to provide more frequent monitoring than once a day is required to detect both sudden releases and slow buildups of hazardous chemicals; these chemicals include (but are not limited to) solvents, mercury and marker chemicals released as a result of overheating electronics. The event monitor which fills this requirement would also be used to monitor the progress of cleanup after a release of hazardous compounds. There have been ongoing efforts to model the polymers used as sensing films in the ENose. These modeling efforts have contributed to a better understanding of the film’s sensing mechanisms. We also hope to be able to use the modeling information to help select films for future array efforts. Training an array for a given set of analytes and a given set of environmental conditions (temperature, pressure, and humidity) is time consuming; in addition, developing training sets and calibration information may impinge on the useful lifetime of the sensors. The predictions can be used to generate virtual training sets for a given sensor array to generate parameters for the identification and quantification software. Subsequently, fewer experimental tests will need to be run on any given sensor array. We will discuss past and present molecular modeling efforts and strategies towards the proper selection of sensing materials as well as the current state of the mathematical models linking molecular and macroscopic experimental measurements.

Figure 1: The Second Generation ENose. The volume of this design is ~760 cm³, about 35% the volume of the First Generation device. The mass is ~ 800 g, about 50% the mass of the First Generation device. The computer can be attached to the back of the device.