Analysis of Membrane Lipids of Airborne Micro-Organisms

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A method of characterization of airborne micro-organisms in a given location involves (1) large-volume filtration of air onto glass-fiber filters; (2) accelerated extraction of membrane lipids of the collected micro-organisms by use of pressurized hot liquid; and (3) identification and quantitation of the lipids by use of gas chromatography and mass spectrometry. This method is suitable for use in both outdoor and indoor environments; for example, it can be used to measure airborne microbial contamination in buildings ("sick-building syndrome"). The classical approach to analysis of airborne micro-organisms is based on the growth of cultureable micro-organisms and does not provide an account of viable but nonculture able micro-organisms, which typically amount to more than 90 percent of the micro-organisms present. In contrast, the present method provides an account of all micro-organisms, including cultureable, nonculture able, aerobic, and anaerobic ones. The analysis of lipids according to this method makes it possible to estimate the number of viable airborne micro-organisms present in the sampled air and to obtain a quantitative profile of the general types of micro-organisms present along with some information about their physiological statuses.

This work was done by Sarah Macnaughton of Microbial Insights, Inc., for **Johnson Space Center**. *For further information, contact the Johnson Commercial Technology Office at (281) 483-3809.*
MSC-22984

Noninvasive Diagnosis of Coronary Artery Disease Using 12-Lead High-Frequency Electrocardiograms

Diagnostically significant signal features can be identified automatically by computational analysis.

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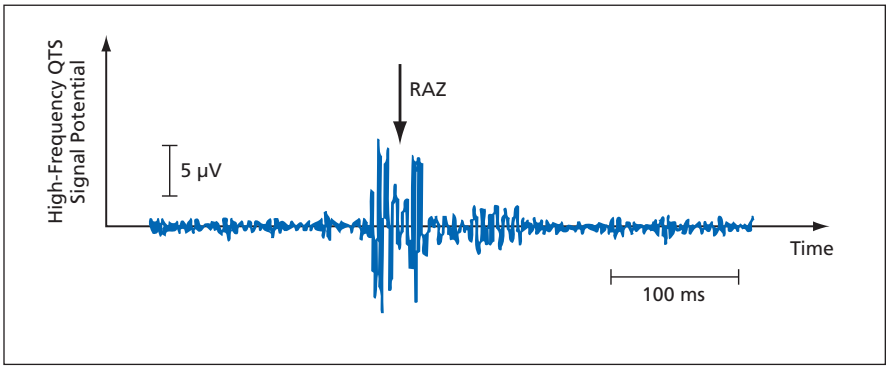
A noninvasive, sensitive method of diagnosing certain pathological conditions of the human heart involves computational processing of digitized electrocardiographic (ECG) signals acquired from a patient at all 12 conventional ECG electrode positions. In the processing, attention is focused on low-amplitude, high-frequency components of those portions of the ECG signals known in the art as QRS complexes. The unique contribution of this method lies in the utilization of signal features and combinations of signal features from various combinations of electrode positions, not reported previously, that have been found to be helpful in diagnosing coronary artery disease and such related pathological conditions as myocardial ischemia, myocardial infarction, and congestive heart failure.



This **High-Frequency QRS Signal** was acquired from a patient having myocardial ischemia. The dip in the amplitude envelope (the RAZ) is a key feature utilized in the present method.

The electronic hardware and software used to acquire the QRS complexes and perform some preliminary analyses of their high-frequency components were summarized in "Real-Time, High-Frequency QRS Electrocardiograph" (MSC-23154), *NASA Tech Briefs*, Vol. 27, No. 7 (July 2003), pp. 26-28. To recapitulate, signals from standard electrocardiograph electrodes are preamplified, then digitized at a sampling rate of 1,000 Hz, then analyzed by the software that detects R waves and QRS complexes and analyzes them from several perspectives. The software includes provisions for averaging signals over multiple beats and for special-purpose nonrecursive digital filters with specific low- and high-frequency cutoffs. These filters, applied to the averaged signal, effect a band-pass operation in the frequency range from 150 to 250 Hz. The output of the band-pass filter is the desired high-frequency QRS signal. Further processing is then performed in real time to obtain the beat-to-beat root mean square (RMS) voltage amplitude of the filtered signal, certain variations of the RMS voltage, and such standard measures as the heart rate and R-R interval at any given time.

A key signal feature analyzed in the present method is the presence versus the absence of reduced-amplitude zones (RAZs). In terms that must be simplified for the sake of brevity, an RAZ comprises several cycles of a high-frequency QRS signal during which the amplitude of the high-frequency oscillation in a portion of the signal is abnormally low (see figure). A given signal sample exhibiting an in-