

Analog Binaural Circuits for Detecting and Locating Leaks

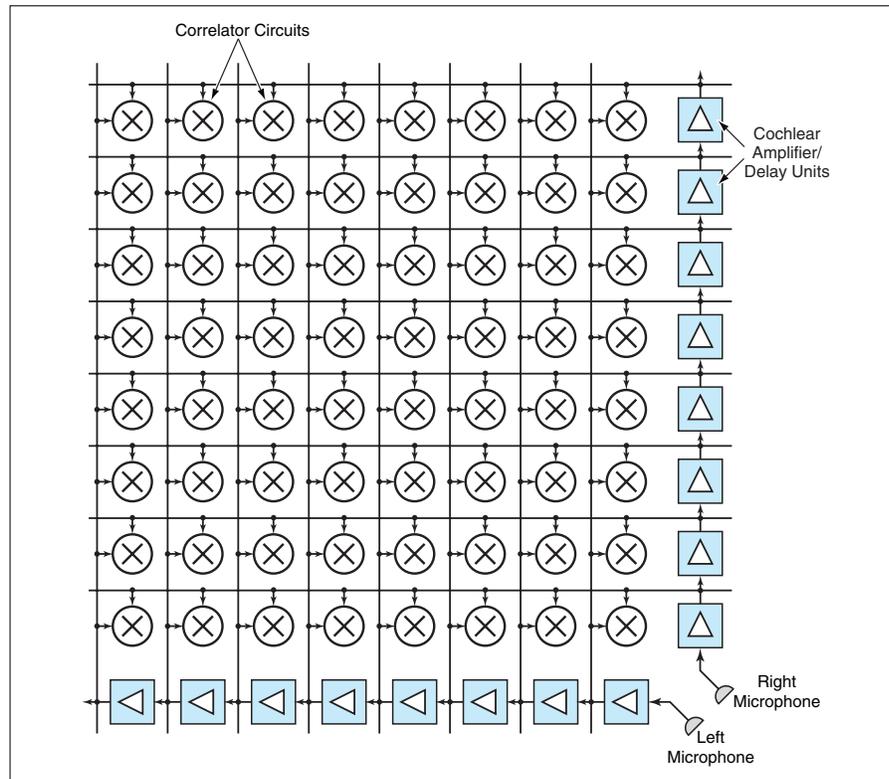
Ultrasonic signals received by paired transducers would be correlated to measure differential delays.

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Very-large-scale integrated (VLSI) analog binaural signal-processing circuits have been proposed for use in detecting and locating leaks that emit noise in the ultrasonic frequency range. These circuits would be designed to function even in the presence of intense lower-frequency background noise that could include sounds associated with flow and pumping. Each of the proposed circuits would include the approximate electronic equivalent of a right and a left cochlea plus correlator circuits.

A pair of transducers (microphones or accelerometers), corresponding to right and left ears, would provide the inputs to their respective cochleas from different locations (e.g., from different positions along a pipe). The correlation circuits plus some additional external circuits would determine the difference between the times of arrival of a common leak sound at the two transducers. Then the distance along the pipe from either transducer to the leak could be estimated from the time difference and the speed of sound along the pipe. If three or more pairs of transducers and cochlear/correlator circuits were available and could suitably be positioned, it should be possible to locate a leak in three dimensions by use of sound propagating through air.

The cochlear circuits would consist mostly of cascades of amplifier/delay units positioned along two orthogonal edges of a rectangular VLSI chip, as depicted in the figure in simplified form. In addition to introducing increments of delay, the cochlear circuits would filter the signals to reject frequencies below the ultrasonic range. The output of a given amplifier/delay unit in a cochlea would



Cochlear and Correlator Circuits, operating in conjunction with external scanning circuits, would implement stereausis.

be fed to both the next amplifier/delay unit in the same cochlea and to a string of correlator circuits, which would form the analogs of the correlations between (1) the output of this unit and (2) the outputs of all amplifier/delay units in the other cochlea. The outputs of the correlator circuits would be scanned by the external circuitry and displayed or otherwise processed to determine which pairings of right and left cochlear units (and thus which differential signal

delay) yields the greatest correlations.

This work was done by Frank T. Hartley of Caltech for NASA's Jet Propulsion Laboratory. Further information is contained in a TSP (see page 1).

This invention is owned by NASA, and a patent application has been filed. Inquiries concerning nonexclusive or exclusive license for its commercial development should be addressed to the Patent Counsel, NASA Management Office-JPL; (818) 354-7770. Refer to NPO-18399.

Mirrors Containing Biomimetic Shape-Control Actuators

Local bending would be controlled to obtain desired surface figures.

NASA's Jet Propulsion Laboratory, Pasadena, California

Curved mirrors of a proposed type would comprise lightweight sheets or films containing integral, biologically inspired actuators for controlling their surface figures. These mirrors could be useful in such applications as collection

of solar energy, focusing of radio beams, and (provided sufficient precision could be achieved) imaging. These mirrors were originally intended for use in outer space, but it should also be possible to develop terrestrial versions.

Several prior NASA Tech Briefs articles have described a variety of approaches to the design of curved, lightweight mirrors containing integral shape-control actuators. The primary distinction between the present approach and the prior ap-