NASA TECH BRIEF

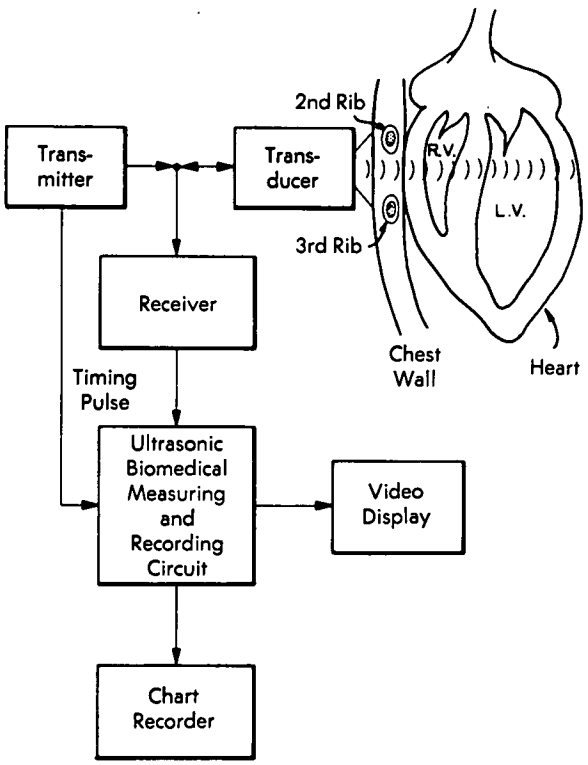
Ames Research Center

Improved Ultrasonic Biomedical Measuring Apparatus

Ultrasonic devices are used to make measurements of certain organs in living specimens and to record their movements. Ordinarily, a series of ultrasonic pulses is beamed into the body of an animal toward an organ, and the train of reflected echo pulses is picked up by a transducer and amplified and detected to provide an output proportional to the distance from the transducer to the organ under observation. The distance signal varies with movement of the organ and can be recorded for visual presentation or future study. Electronically controlled gates between the echo receiver and the display or recording element are used for isolating the echoes which occur at a selected time interval after each transmitted ultrasonic pulse; observation of movements of certain portions of an organ (for example, a valve of the heart) is then made possible. Also, there is included an automatic gate depth-control circuit which is intended to center the selected echo signals within the gate interval and thus the signal-to-noise ratio of the apparatus is improved. The gate depth-control detects the first peak of the selected echo, and its position relative to the center of the gating interval is employed to obtain an error signal for centering the first peak of the selected echo within the gating interval.

Unfortunately, a typical echo signal contains a plurality of peaks, and the first peak of the echo signal may not occur in the center of the selected echo signal; if the echo signal is not centered in the gating interval, the gate must be wider than necessary and, therefore, echo signals are obtained from other reflective elements not under observation. Furthermore, if the gating period is too narrow, the desired signal is lost.

The diagram indicates the major components of an ultrasonic measuring apparatus incorporating an improved electronic gate. An ultrasonic transducer is coupled to the skin of an animal under observation



and positioned to direct its beam of ultrasonic wave energy into the portion of the body under observation, for example, the heart of a patient with a cardiac ailment. An ultrasonic transmitter energizes the transducer with a train of pulsed energy, typically 2.25 MHz with pulse duration of one to several microseconds

(continued overleaf)

and a pulse repetition frequency of one thousand per second. Echoes received by the transducer after each pulse of ultrasonic energy are fed to an ultrasonic receiver where they are amplified and then processed for video display or for recording on chart paper.

The ultrasonic biomedical measuring and recording circuit indicated in the diagram includes a video detector which passes a train of video echo pulses to a squaring amplifier. Each group of the squared echoes is fed to a diode gate; the diode gate, via a delayed gating interval (window), selects the portions of the squared video echo pulses which are to be processed further. For example, the output from the gate is fed to a pulse amplifier and the leading edge of the selected echo pulse is differentiated to provide a switching signal for interrupting an integrator that was started by the initial transmitter pulse; hence, the charge or voltage developed by the integrator is a measure of the distance from the transducer to the element under observation, and the DC level is held until the next transmitter pulse is beamed into the animal. The DC level varies with movement of the organ, and since it is passed from the integrator through an active low-pass filter to a recorder, motions of the organ are easily observed.

Ultrasonic measuring devices of the type described above are further improved by use of an electronic gate for which the depth or time delay relative to the transmitted pulse is automatically controlled by a difference or error signal derived by subtracting the integrals of the selected echo signal during the first and second halves of the gating interval; operation in this mode assures that the gate interval is centered with respect to the desired echo signal.

Note:

No additional documentation is available. Specific questions, however, may be directed to:

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Patent status:

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