The thermal pulse decay technique for measuring [illegible]

[illegible]

desired solution for the temperature following the ultrasonic pulse:

$$T(r,t) = \{T_{\max}/[(4k/\beta)t + 1]\}e^{-r^2/(4kt+\beta)}. \qquad (10)$$

At $t = 0$, Eq. (10) reduces to the initial condition given

by Eq. (2). In the commonly used case of a focal region centered on the thermojunction, the distance r is zero and Eq. (10) reduces to

$$T(0,t) = T_{\max}/[(4k/\beta)t + 1]. \qquad (11)$$

III. RESULTS AND DISCUSSION

A. Comparison with the rate-of-heating method

Both the pulse–decay and rate-of-heating techniques

were used to determine the absorption coefficients of soft polyethylene and samples of beef liver, muscle, and kidney

cortex, at frequencies between 0.6 and 2.7 MHz. The two techniques were found to agree on measured values within a we also note that the pulse-decay technique requires knowledge of the tissue thermal diffusivity k, as well as the quanti-

The ratio of T [illegible] /T [illegible]

as evidenced by pulse-decay curves obtained in soft tissues at

C. Off-axis applications of the pulse-decay technique

A significant advantage of the pulse-decay technique is the ability to separate the thermocouple and the region of highest intensity by a lateral distance r. The problems discussed in the previous section are thereby alleviated because, when off-axis measurements are made, the thermocouple wire is at all times subjected to a greatly reduced temperature gradient and ultrasonic intensity. This diminishes measurement errors due to conduction along the thermocouple wires

using Eq. (10), with the value of $T_{\max}$ obtained from a curve fit of $r = 0.0$ cm data (not shown but closely overlapping the $r = 0.02$ cm curve) between 8 and 10 s.

The nearly centered curve ($r = 0.02$ cm) is initially dominated by viscous heating with the peak temperature rising off the scale of Fig. 6. The precise value of the peak temperature at the thermocouple surface, including the viscous heating effect, is difficult to assess due to the low-pass period of time Δt which is short compared to the time required for conduction effects to take place, then the temperature distribution at the end of the pulse is given by

$$T_I(r,z) = T_{\max} e^{-r^2/\beta_r} e^{-z^2/\beta_z}, \tag{22}$$

where the relation between I and T is given by Eq.

IV. CONCLUSION

The pulse-decay technique provides an experimental alternative to the rate-of-heating method for measuring ultrasonic absorption coefficients. The pulse-decay technique explicitly accounts for heat conduction in a material as well as