

LETTER TO THE EDITOR

Dielectric Loss Transients

Dear Sir:

We presented a paper entitled "Dielectric Loss and Voltage Clamp Transients" (Cole and FitzHugh, 1971) at the Biophysical Society Meeting, February 1971. This work was continued with improved methods and published with computed data for the transients under the title "Voltage and Current Clamp Transients with Membrane Dielectric Loss" (FitzHugh and Cole, 1973). We have just learned of a publication by Koizumi and Kita (1972) which presents similar results. They derived convergent and asymptotic series expansions for two functions ϕ and Φ , which can be expressed in terms of our function f as follows:

$$\begin{aligned}\Phi(t) &= 1 - f(t/\tau), \\ \phi(t) &= \Phi'(t) = -f'(t/\tau)/\tau,\end{aligned}$$

where the prime indicates the first derivative.

Using the two series expansions, they computed in double precision values of $\phi(t)$ and $\Phi(t)$ for a range of values of t/τ (\bar{t} in our notation). Their parameter β (equal to our α) was varied from 0.30 to 1.00 in steps of 0.02; we computed $f(\bar{t})$ for $\alpha = 0.50, 0.60$, and from 0.70 to 1.00 in steps of 0.05. A spot check of the numerical results shows perfect agreement between their values of $\Phi(t)$ and ours of $f(\bar{t})$. They reported five significant figures throughout; we gave four or more. We included one more decade of values of t at both the low and the high ends than they did. We published three values per decade of \bar{t} , but provided a table of 10 values per decade on request. They published 10 values per decade. We did not compute values of $f'(\bar{t})$, corresponding to their function ϕ .

We were not so successful as Koizumi and Kita in using the series to compute dependable values of $f(\bar{t})$ for values of \bar{t} near 10 and 20, where many terms are required. However, we derived a rational approximation useful for these midrange values. In addition to the Cole-Cole equation which we used to describe the dielectric properties, Koizumi and Kita computed results for the somewhat different Davidson-Cole equation.

We are glad to see the more extensive results published by Koizumi and Kita, and to find agreement between their results and ours. We believe that their paper will be of use to those interested in comparing such computations with experimental data from nerve and other membranes.

REFERENCES

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