

PHYS 306: Computational Physics Lab (E&M)

Winter 2023

Exercise 5.1

1. Write a program to compute the retarded time $t_{\text{ret}}(\mathbf{r}, t)$ for the field at position \mathbf{r} and time t due to a moving particle with position $\mathbf{R}(t)$. The retarded time is defined implicitly by

$$t_{\text{ret}} = t - |\mathbf{r} - \mathbf{R}(t_{\text{ret}})|/c.$$

Use bisection with an initial bracketing range $[t - 2r/c, t]$, where $r = |\mathbf{r}|$, and plot t_{ret} at $\mathbf{r} = (5, 5)$ as a function of t for $0 < t < 20$, assuming

$$(a) \quad \mathbf{R}(t) = (\alpha e^t, 0) \quad (t < 0)$$

$$(b) \quad \mathbf{R}(t) = (\alpha \cos t, \alpha \sin t) \quad (t \geq 0)$$

where we will take $\alpha = 0.5$ and $c = 1$.

Operationally, we will determine t_{ret} as the solution to the equation $g(z) = 0$, where

$$g(z) = z - t - |\mathbf{r} - \mathbf{R}(z)|/c.$$