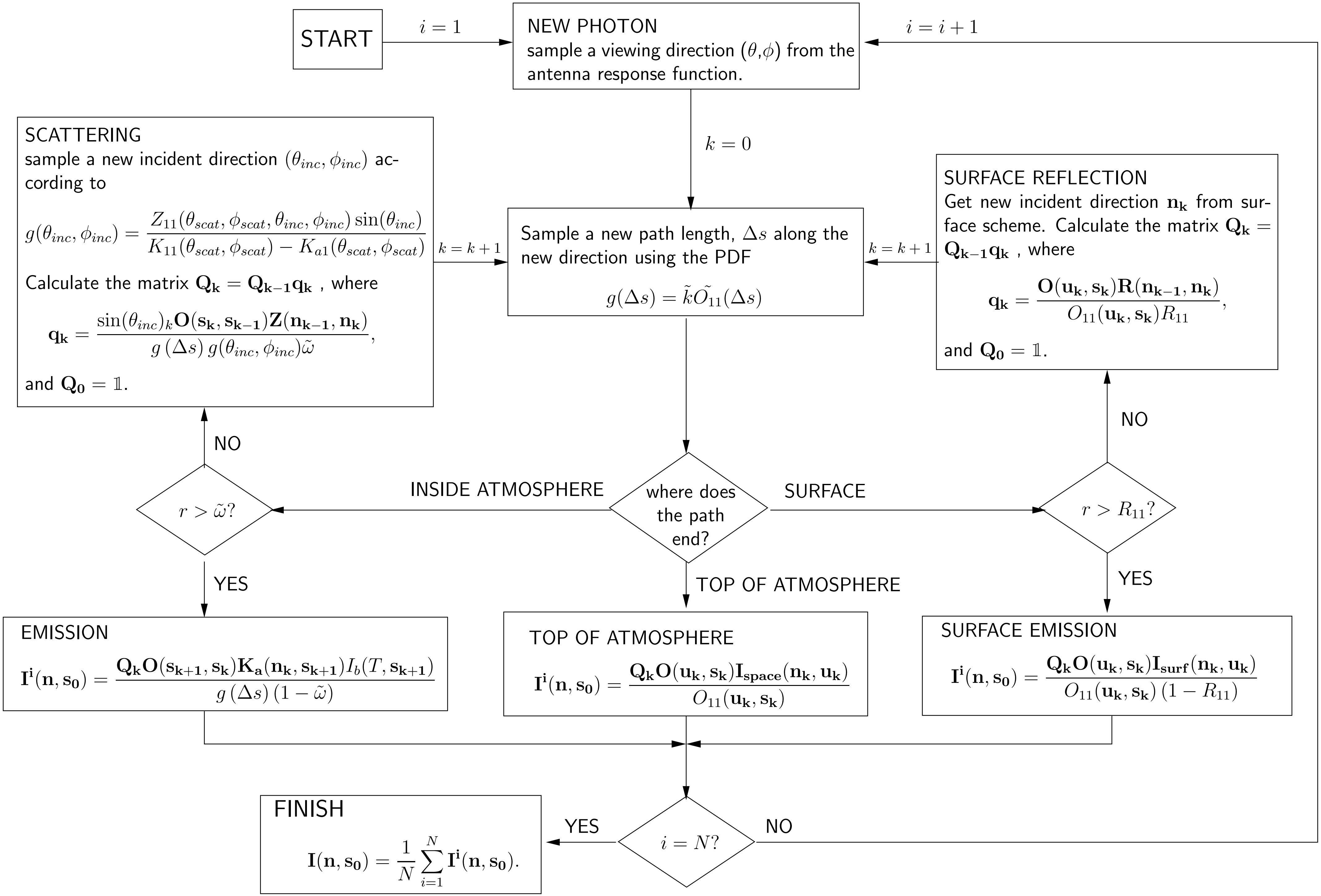
START
$i = 1$
NEW PHOTON
sample a viewing direction (θ,ϕ) from the antenna response function.
$i = i + 1$
$k = 0$
SCATTERING
sample a new incident direction $(\theta_{inc}, \phi_{inc})$ according to
$g(\theta_{inc}, \phi_{inc}) = \frac{Z_{11}(\theta_{scat}, \phi_{scat}, \theta_{inc}, \phi_{inc}) \sin(\theta_{inc})}{K_{11}(\theta_{scat}, \phi_{scat}) - K_{a1}(\theta_{scat}, \phi_{scat})}$
Calculate the matrix $\mathbf{Q_k} = \mathbf{Q_{k-1}} \mathbf{q_k}$, where
$\mathbf{q_k} = \frac{\sin(\theta_{inc})_k \mathbf{O}(\mathbf{s_k}, \mathbf{s_{k-1}}) \mathbf{Z}(\mathbf{n_{k-1}}, \mathbf{n_k})}{g\,(\Delta s)\, g(\theta_{inc}, \phi_{inc}) \tilde{\omega}}$,
and $\mathbf{Q_0} = \mathbb{1}$.
$k = k + 1$
Sample a new path length, Δs along the new direction using the PDF
$g(\Delta s) = \tilde{k}\tilde{O_{11}}(\Delta s)$
$k = k + 1$
SURFACE REFLECTION
Get new incident direction $\mathbf{n_k}$ from surface scheme. Calculate the matrix $\mathbf{Q_k} = \mathbf{Q_{k-1}} \mathbf{q_k}$, where
$\mathbf{q_k} = \frac{\mathbf{O}(\mathbf{u_k}, \mathbf{s_k}) \mathbf{R}(\mathbf{n_{k-1}}, \mathbf{n_k})}{O_{11}(\mathbf{u_k}, \mathbf{s_k}) R_{11}}$,
and $\mathbf{Q_0} = \mathbb{1}$.
NO
NO
$r > \tilde{\omega}$?
INSIDE ATMOSPHERE
where does the path end?
SURFACE
$r > R_{11}$?
YES
TOP OF ATMOSPHERE
YES
EMISSION
$\mathbf{I^i}(\mathbf{n}, \mathbf{s_0}) = \frac{\mathbf{Q_k} \mathbf{O}(\mathbf{s_{k+1}}, \mathbf{s_k}) \mathbf{K_a}(\mathbf{n_k}, \mathbf{s_{k+1}}) I_b(T, \mathbf{s_{k+1}})}{g\,(\Delta s)\,(1 - \tilde{\omega})}$
TOP OF ATMOSPHERE
$\mathbf{I^i}(\mathbf{n}, \mathbf{s_0}) = \frac{\mathbf{Q_k} \mathbf{O}(\mathbf{u_k}, \mathbf{s_k}) \mathbf{I_{space}}(\mathbf{n_k}, \mathbf{u_k})}{O_{11}(\mathbf{u_k}, \mathbf{s_k})}$
SURFACE EMISSION
$\mathbf{I^i}(\mathbf{n}, \mathbf{s_0}) = \frac{\mathbf{Q_k} \mathbf{O}(\mathbf{u_k}, \mathbf{s_k}) \mathbf{I_{surf}}(\mathbf{n_k}, \mathbf{u_k})}{O_{11}(\mathbf{u_k}, \mathbf{s_k})\,(1 - R_{11})}$
FINISH
$\mathbf{I}(\mathbf{n}, \mathbf{s_0}) = \frac{1}{N} \sum_{i=1}^{N} \mathbf{I^i}(\mathbf{n}, \mathbf{s_0})$.
YES
$i = N$?
NO