Computational light scattering, fall 2022 (PAP315, 5 cr), Exercise 4

The answers are due on **October 5, 2022**. Please return them to Anne Virkki via e-mail (anne.virkki@helsinki.fi).

1. Consider the Henyey-Greenstein single-scattering phase function (subscript HG)

$$P_{\mathrm{HG}}(\theta) \quad = \quad \frac{1-g^2}{(1+g^2-2g\cos\theta)^{\frac{3}{2}}},$$

where θ is the scattering angle and g is the asymmetry parameter, that is, the average of $\cos\theta$ for the given P_{HG}. In Monte Carlo radiative transfer ignoring polarization, given a uniform random deviate $y \in]0,1[$, what is the corresponding scattering angle resulting from the HG phase function? (6 points)

2-4. Consider radiative transfer in a spherical medium (ignoring polarization) with radial optical thickness τ composed of Henyey-Greenstein scatterers with the single-scattering albedo $\tilde{\omega}$ and phase function P_{HG} given in Question 1. In the case of unidirectional unpolarized incident radiation (e.g., the Sun as the source), compute the angular distribution of scattered radiation as well as the amount of absorbed radiation by writing a Monte Carlo computer program for the radiative transfer problem at hand. As an example, depict the angular distribution for $\tau = 2$, $\tilde{\omega} = 0.9$, and $g = 0.6$ in P_{HG}. (18 points)