Lesson no. 4

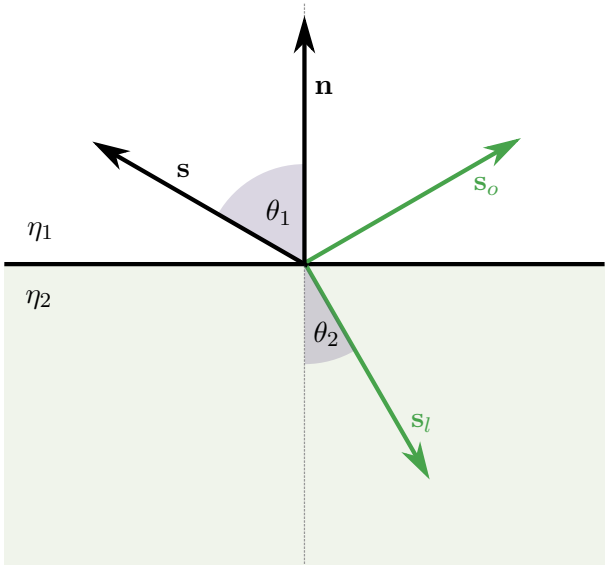
6 March 2023

1. Calculate the light intensity using Lambertian reflectance in the point $(0, 10, 0)^\top$, which lies on a surface with the normal vector $\mathbf{n} = (0, 1, 0)^\top$ and the coordinates of the light source are $(20, 20, 40)^\top$.

2. Using the *Snell's law* $\eta_1 \sin\theta_1 = \eta_2 \sin\theta_2$, and the fact $\|\mathbf{s}\| = \|\mathbf{n}\| = 1$, prove that following equations for an ideally reflected and refracted ray hold:

$$\mathbf{s}_o = 2(\mathbf{s}\cdot\mathbf{n})\mathbf{n} - \mathbf{s}$$

$$\mathbf{s}_l = -\frac{\eta_1}{\eta_2}(\mathbf{s} - (\mathbf{s}\cdot\mathbf{n})\mathbf{n}) - \sqrt{1 - \left(\frac{\eta_1}{\eta_2}\right)^2 (1 - (\mathbf{s}\cdot\mathbf{n})^2)}\,\mathbf{n}$$



3. Air has the refraction index equal to 1.00026 and for water it is 1.33. Consider the ray passing from the water into the air. Compute the critical angle for the water, i.e. when the total internal reflections occurs.

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