Reflection Details

\[ \hat{s} + \hat{r} = k \hat{\mathbf{n}} \quad \text{and} \quad \hat{n} \cdot \hat{s} = \hat{n} \cdot \hat{r} \]

\[ \hat{n} \cdot \hat{s} - \hat{n} \cdot \hat{r} = k \Rightarrow k = 2 \hat{\mathbf{n}} \cdot \hat{s} \]

So \[ \hat{r} = 2(\hat{n} \cdot \hat{s})\hat{n} - \hat{s} \]

Sphere details (H&B, 602)
Index of refraction, \( n \), is the ratio of speed of light in a vacuum, to speed of light in medium.

Typical values:
- air: 1.00 (nearly)
- water: 1.33
- glass: 1.45-1.6
- diamond: 2.2

The indices of refraction for the two media, and the incident angle, \( \theta_i \), yield the refracted angle \( \theta_r \). (Also need planarity.)
Surface detail

- Texture maps:
  - Make albedo (or color) a function of position in these coordinates
  - Rendering: when intersection with a casted ray is found, compute coordinates and get albedo from a map
  - This is not specific to ray-tracing

From RmanNotes: http://www.cgrg.ohio-state.edu/~smay/RManNotes/index.html

Surface detail, II

- Bumps
  - we assume that the surface has a set of bumps on it
  - e.g. the pores on an orange
  - these bumps are at a fine scale, so don’t really affect the point of intersection with casted rays, but do affect the normal
  - strategy:
    - obtain normal from “bump function”
    - shade using this modified normal
    - notice that some points on the surface may be entirely dark
    - bump maps might come from pictures (like texture maps)
Surface detail, III

- A more expensive trick is to have a map which includes displacements as well.
- Must be done before visibility.