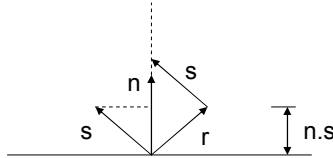


Computing r

- Need to compute angle between viewing direction and reflection direction
 - v is given (the viewer direction)
- But what is n?
 - (the incident ray), and the direction of outgoing light reflected (the reflected ray) make the same angle with respect to the surface normal
 - s, r, n unit vectors
- The projection of s onto n is n.s. Then, according to the diagram below and the angle symmetry:

$$\begin{aligned} \mathbf{r} + \mathbf{s} &= (\mathbf{s} \cdot \mathbf{n} + \mathbf{r} \cdot \mathbf{n})\mathbf{n} \\ &= (2\mathbf{n} \cdot \mathbf{s})\mathbf{n} \end{aligned}$$

Rearranging, $\mathbf{r} = (2\mathbf{n} \cdot \mathbf{s})\mathbf{n} - \mathbf{s}$



“Optimised” Specular Model

- Instead of using $\mathbf{v} \cdot \mathbf{r}$ (for $\cos f$), we use $\mathbf{n} \cdot \mathbf{h}$ (for $\cos a$), where \mathbf{n} is the normal of the surface, and \mathbf{h} is the halfway vector between \mathbf{s} and \mathbf{v} .
- When \mathbf{l} , \mathbf{n} and \mathbf{v} are co-planar, $a = f/2$.
- We use $\mathbf{n} \cdot \mathbf{h}$ instead of $\mathbf{v} \cdot \mathbf{r}$ because $\mathbf{n} \cdot \mathbf{h}$ requires less calculations.

$$\mathbf{h} = \frac{\mathbf{s} + \mathbf{v}}{|\mathbf{s} + \mathbf{v}|}$$

