Physically Based Rendering (600.657)

Materials

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– Plastic: combine glossy with diffuse

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with:

- *Kd*: diffuse color
- *Ks*: specular/gloss color
- F_r: Fresnel dielectric term
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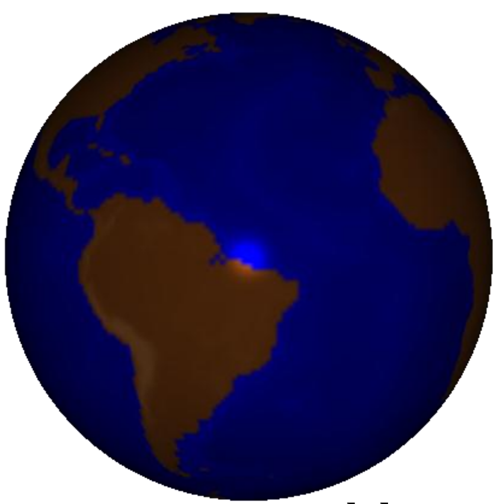
In general, the properties are described by textures, allowing material properties to vary spatially.

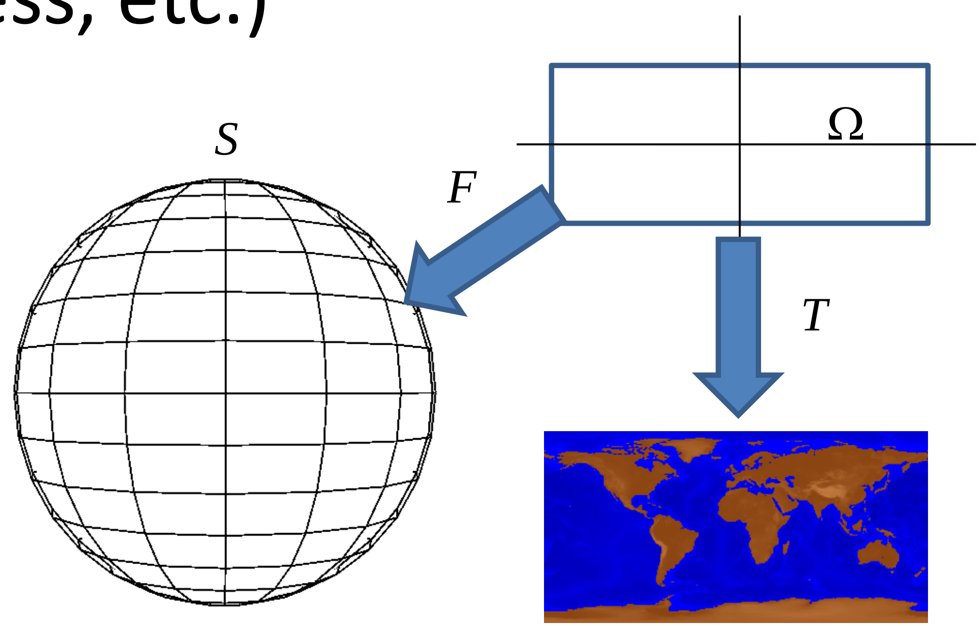
Textures

We have a bijective map $F{:}\Omega\rightarrow S$, from a domain $\Omega\subset\mathbf{R}^2$ to the surface $S\subset\mathbf{R}^3$.

We also have a set of textures $T{:}\Omega$ mapping from the domain Ω to material parameters (e.g. colors, roughness, etc.)



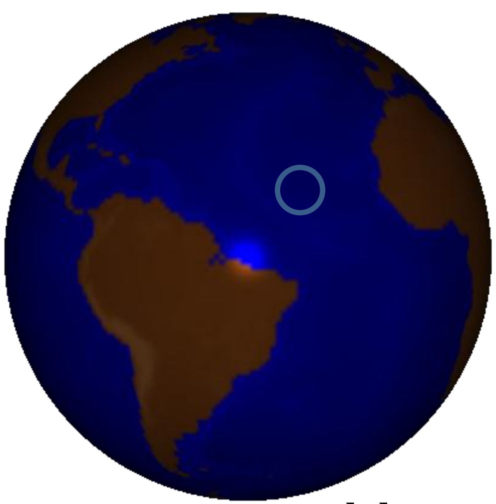
Target Model



Textures

For a given point of intersection, $p \in S$, we evaluate the texture to get the material parameter:

$$Kd(p) = T_{Kd}\left(F^{-1}(p)\right)$$



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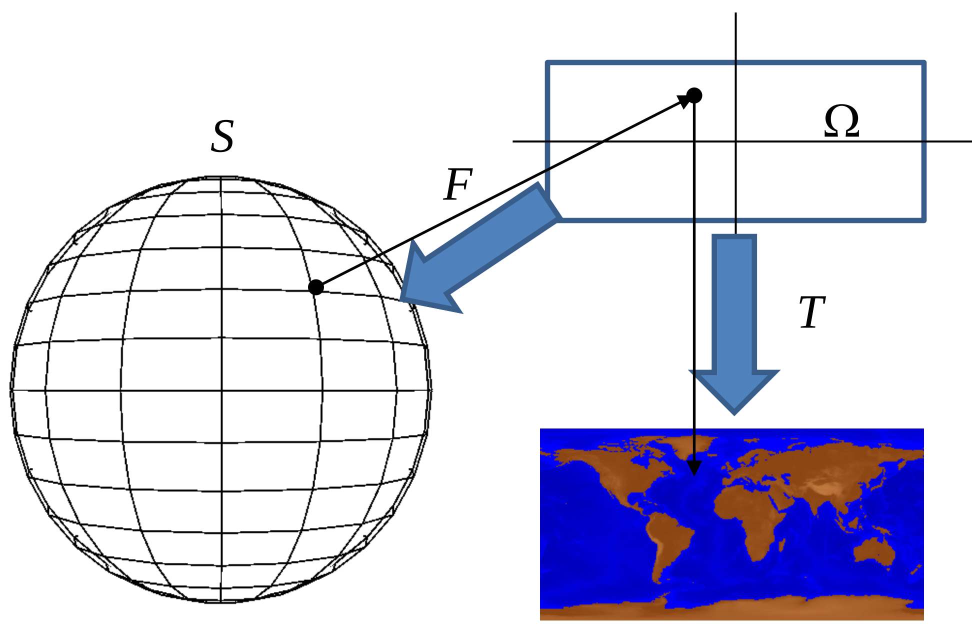

Texture Maps

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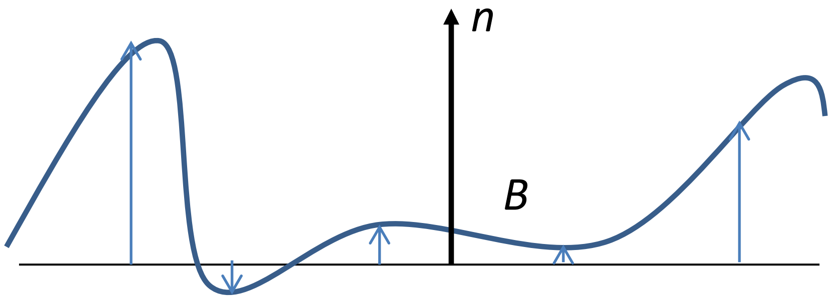

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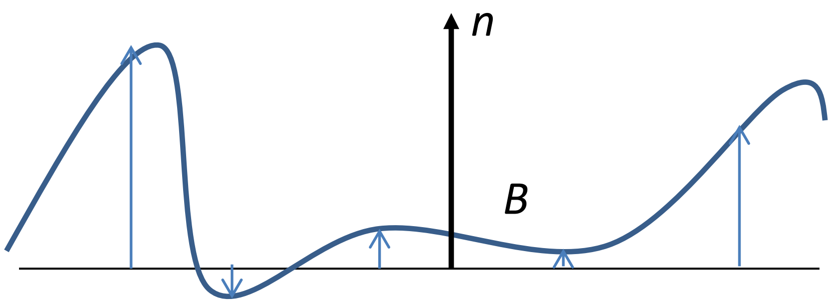
The parameterization of the bumped surface is then:



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Bump Maps

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To compute the normal of the new surface, we compute the two tangents:

$$\frac{\partial F^{new}}{\partial x} = \frac{\partial F}{\partial x} + \frac{\partial B}{\partial x} n + B\frac{\partial n}{\partial x}$$

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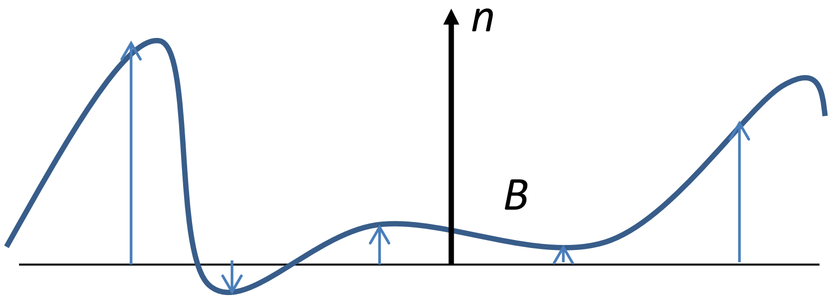

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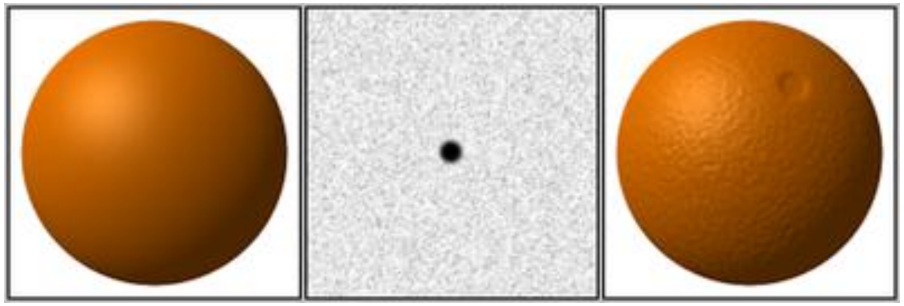
and take the cross-product:

$$n^{new} = \frac{\frac{\partial F^{new}}{\partial x} \times \frac{\partial F^{new}}{\partial y}}{\left\| \frac{\partial F^{new}}{\partial x} \times \frac{\partial F^{new}}{\partial y} \right\|}$$



[Wikipedia]

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In practice, it may not be possible to explicitly differentiating the texture (e.g. it may be procedural).

However, we can always approximate it by differencing:

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A change by a distance of Δx in the parameter domain should correspond in a shift on the order of a pixel in the image.