

# Image Processing and Computer Graphics

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# 1 Introduction Computer Graphics

Modeling: generate, represent geometry.  
 Rendering: light transposing, delete objects etc.  
 Simulation: animation, dynamic representation.

**Light:** energy or photons generated by a source, transported along lines, interacting at surfaces (reflection).

Task



Governing equations

$$\frac{d\mathbf{v}_i^t}{dt} = \mathbf{a}_i^t = -\frac{1}{\rho_i^t} \nabla p_i^t + \nu \nabla^2 \mathbf{v}_i^t + \mathbf{g} \quad \frac{d\mathbf{x}_i^t}{dt} = \mathbf{v}_i^t$$

*Handwritten notes: "acc." above the acceleration term, "viscosity (!)" above the viscosity term, "gravity." below the gravity term, and "density variation." with an arrow pointing to the density term in the continuity equation.*

$$\frac{d\rho_i^t}{dt} = -\rho_i^t \nabla \cdot \mathbf{v}_i^t = 0$$

Numerics

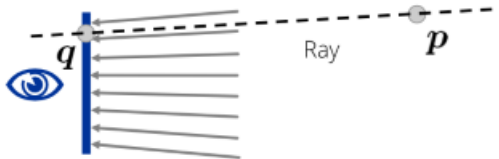
$$\nabla p_i^t \approx \sum_j \frac{m_j}{\rho_j^t} p_j^t \nabla W_{ij}^t \quad \nabla^2 \mathbf{v}_i^t \approx \sum_j \dots$$

$$\mathbf{v}_i^{t+\Delta t} = \dots \quad \mathbf{x}_i^{t+\Delta t} = \dots$$

Pressure is computed by solving a pressure Poisson equation.

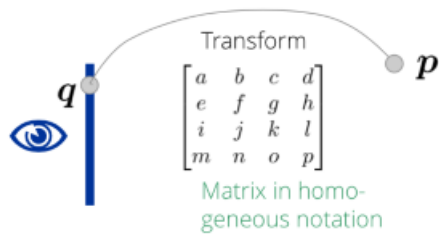
## 1.1 Rendering aspects

- Ray Tracing:



Ray Tracers compute  
 ray-scene intersections  
 to estimate  $q$  from  $p$ .

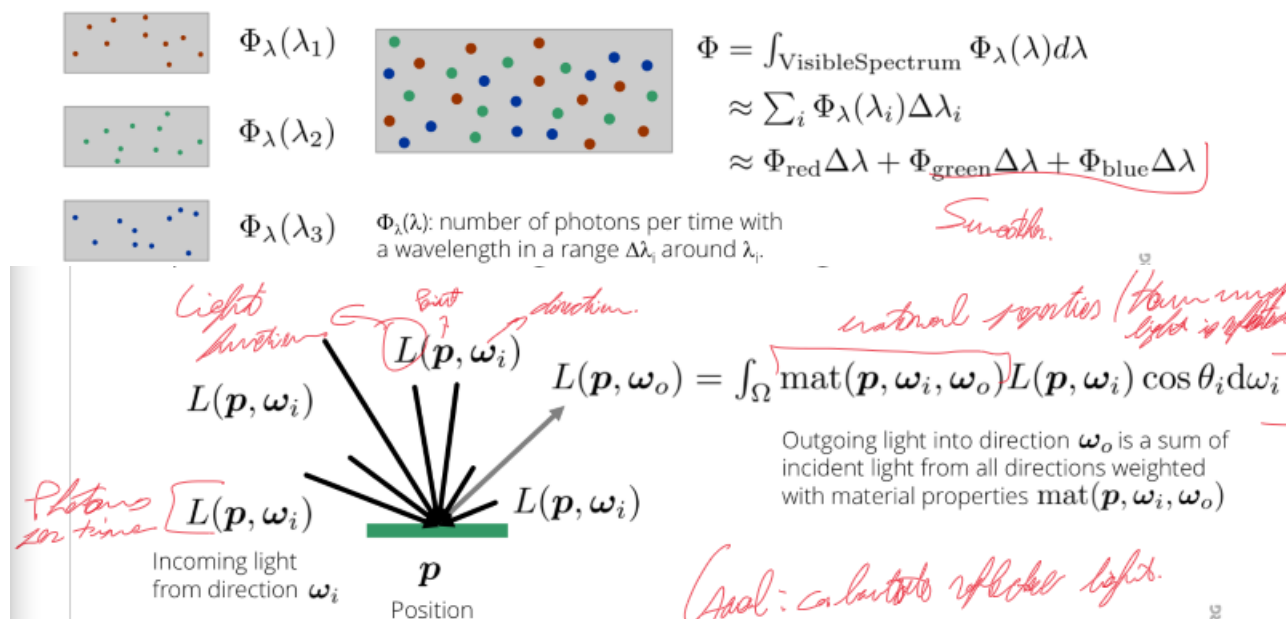
- Rasterization:



Rasterizers apply transformations to  $p$  in order to estimate  $q$ .  $p$  is projected onto the sensor plane.

## 1.2 Light

Photons are characterized by a wavelength within the visible spectrum = color.



Rendering -  $\lambda$  lookup light transported along rays casted into the scene.

## 2 Ray Casting