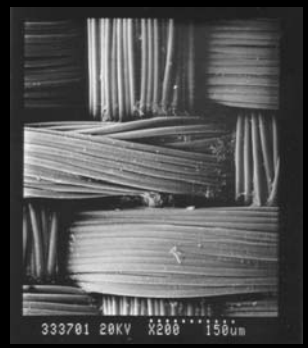
An Implicit Approach to Cloth Synthesis

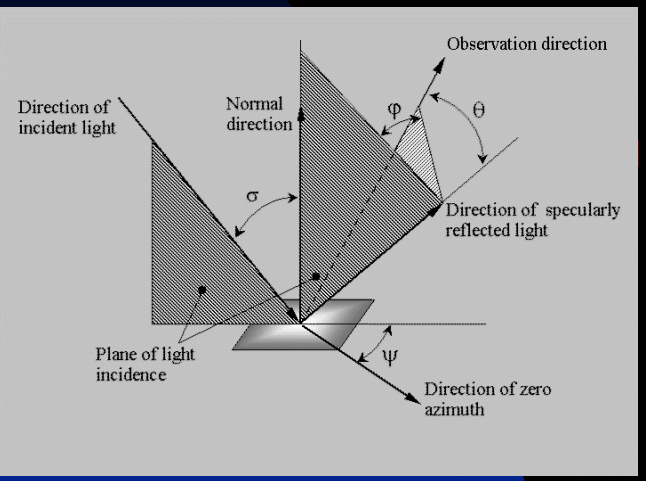
GraphiCon’ 99

Introduction

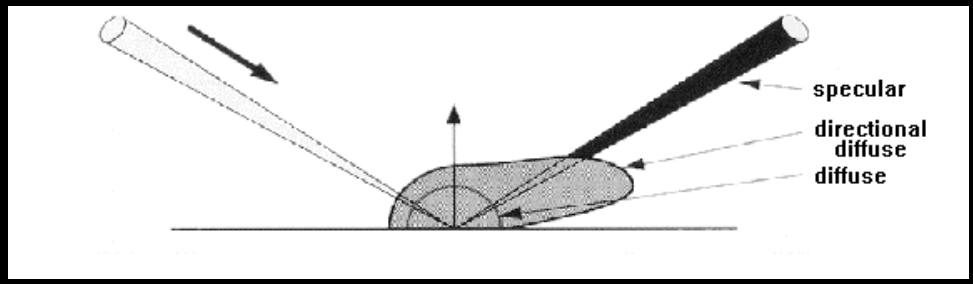
- A problem of Cloth visualization
  - Applications:
    - Animation, Art
    - Fashion design
    - Design of new fabric
  - Far view
  - Close view

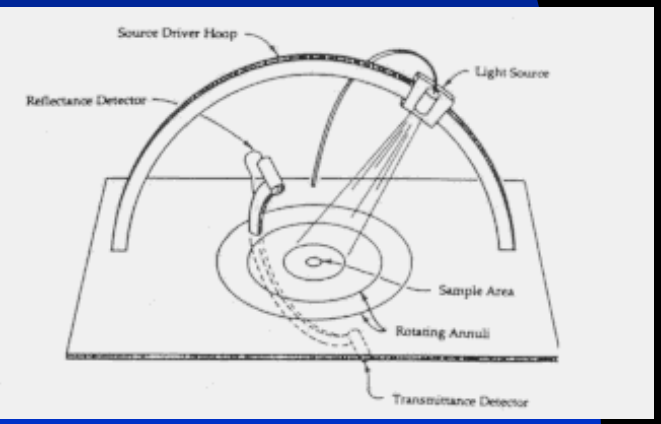


Cloth reflection model



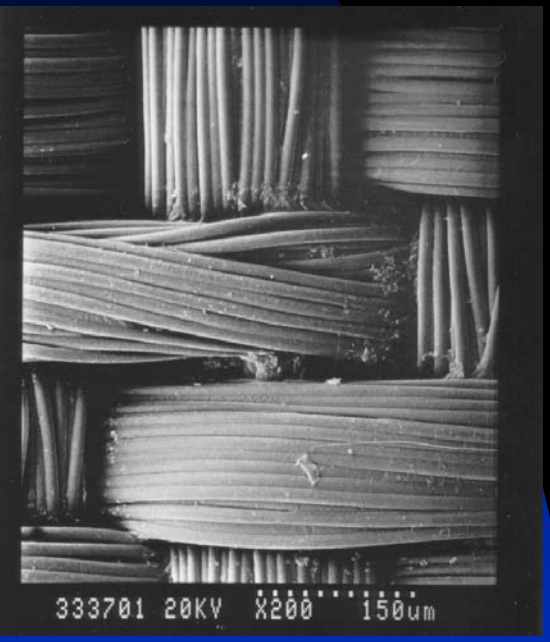
Anisotropic reflection



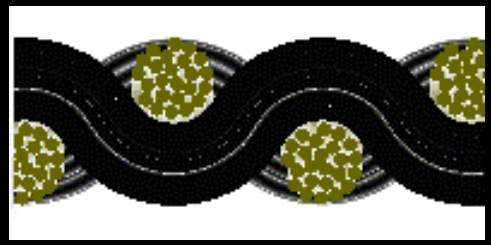


- BRDF
- Gonioreflectometer

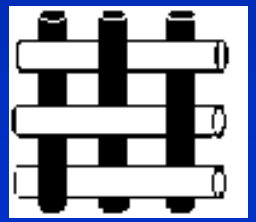
Previous work

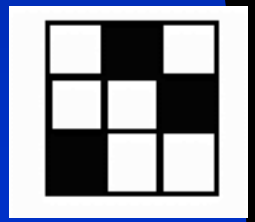


- An Approach to Cloth Synthesis and Visualization (Graphicon'97)
  - Explicit cloth model



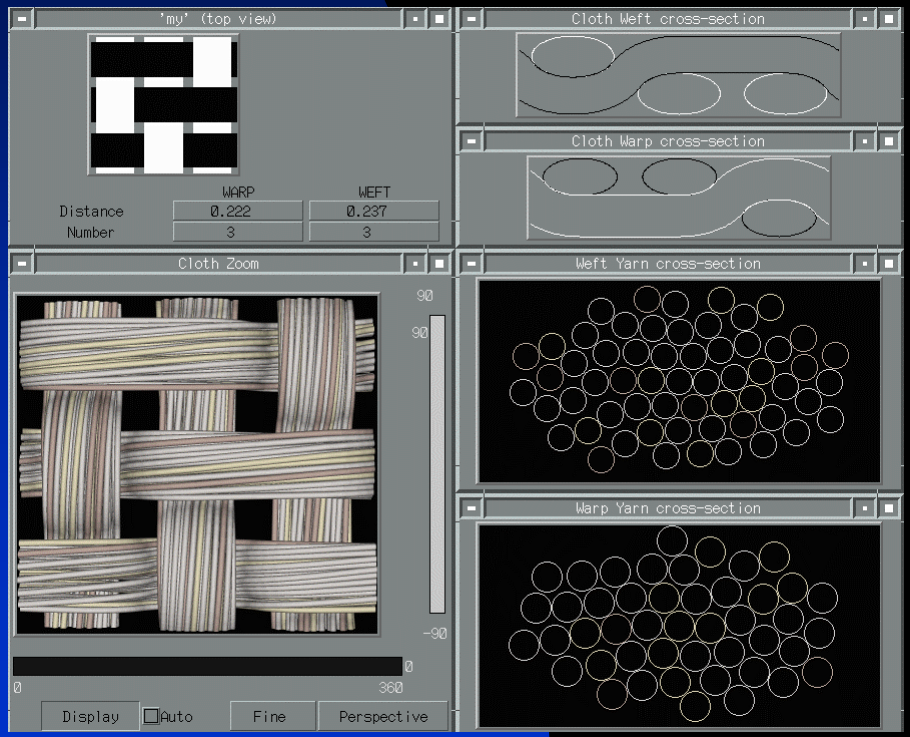
  - Virtual goniometric spectrophotometer





Cloth design

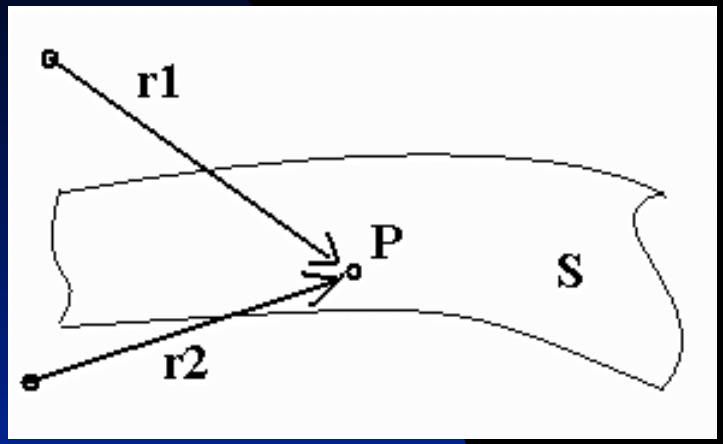
- Modeling of explicit knitting pattern

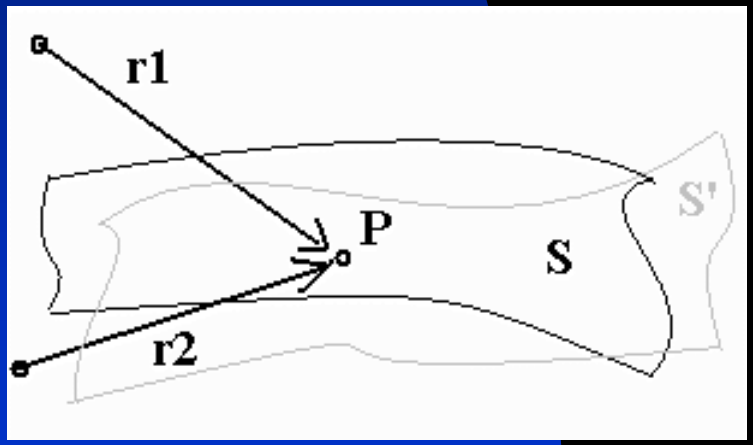


Cloth elements

- Deterministic elements:
  - Knitting pattern
  - Color of yarns
  - Number of fibers in yarns
  - Fiber cross-section shape
- Probabilistic elements:
  - Fiber distribution along yarns
  - Fiber surface roughness

Light propagation in cloth

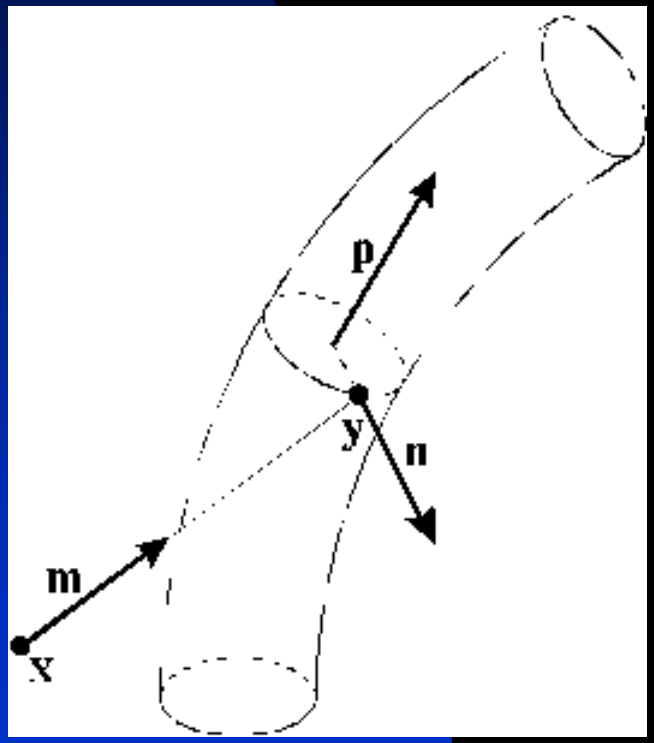


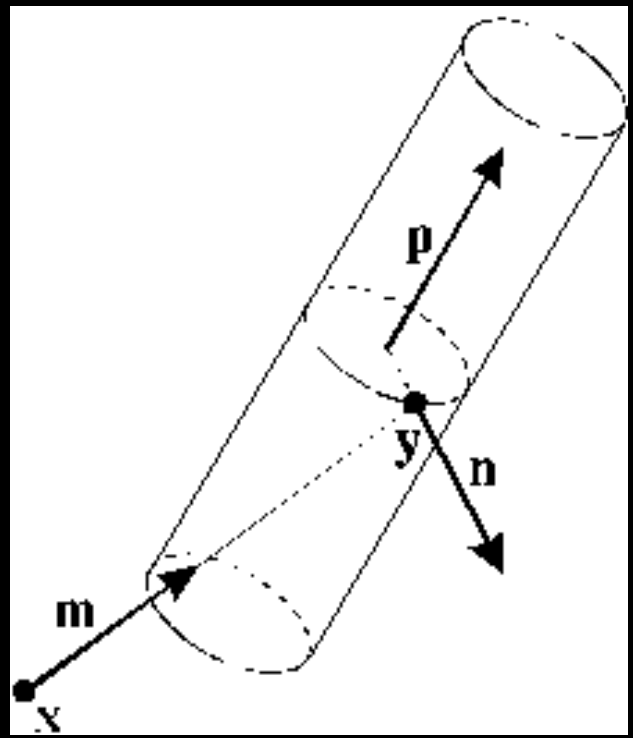


- Deterministic approach
- Statistical approach

Stochastic Ray Tracing

- srta(x, m, f) = (y, n, p)





Cloth characteristics

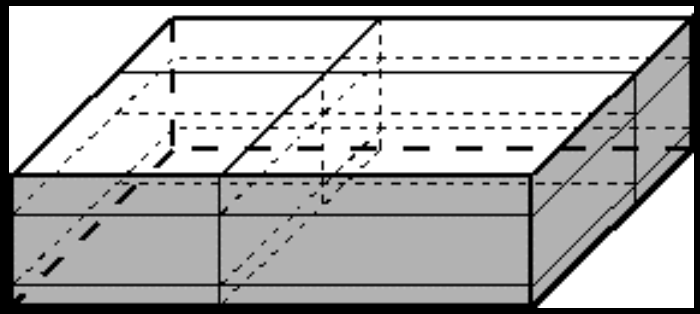
- Specific Length of fibers
  - $dl = f(\mathrm{p}, \mathrm{x})\, d\Omega\, dV$
    - p - fiber direction
    - x - point in the space
    - $d\Omega$ - solid angle element
    - dV - volume element
- Specific visible area
  - $ds_m = h(\mathrm{m}, \mathrm{p}, \mathrm{x})\, d\Omega\, dV$
    - m - ray direction
- Total specific visible area
  - $dS_m = H(\mathrm{m}, \mathrm{x})\, dV$
  - $H(\mathrm{m}, \mathrm{x}) = \int_{\mathrm{p} \in E^+} h(\mathrm{m}, \mathrm{p}, \mathrm{x})\, d\Omega$

Stochastic Ray Tracing

- $P\{|x-y| < t\} = 1 - \exp(-at)$
  - $a = H(m, x), \quad t \geq 0$
  - x - ray origin, m - ray direction
  - y - nearest ray-fiber intersection
- $dp = h(m, p, x) / H(m, x)\, d\Omega$
  - $p \in E^+$ - fiber direction
- $n = \sqrt{(1-a^2)}\,[(m,p)p - m] + a[m \times p]$
  - a – projection of n to $[m \times p]$, $a \in [-1, 1]$

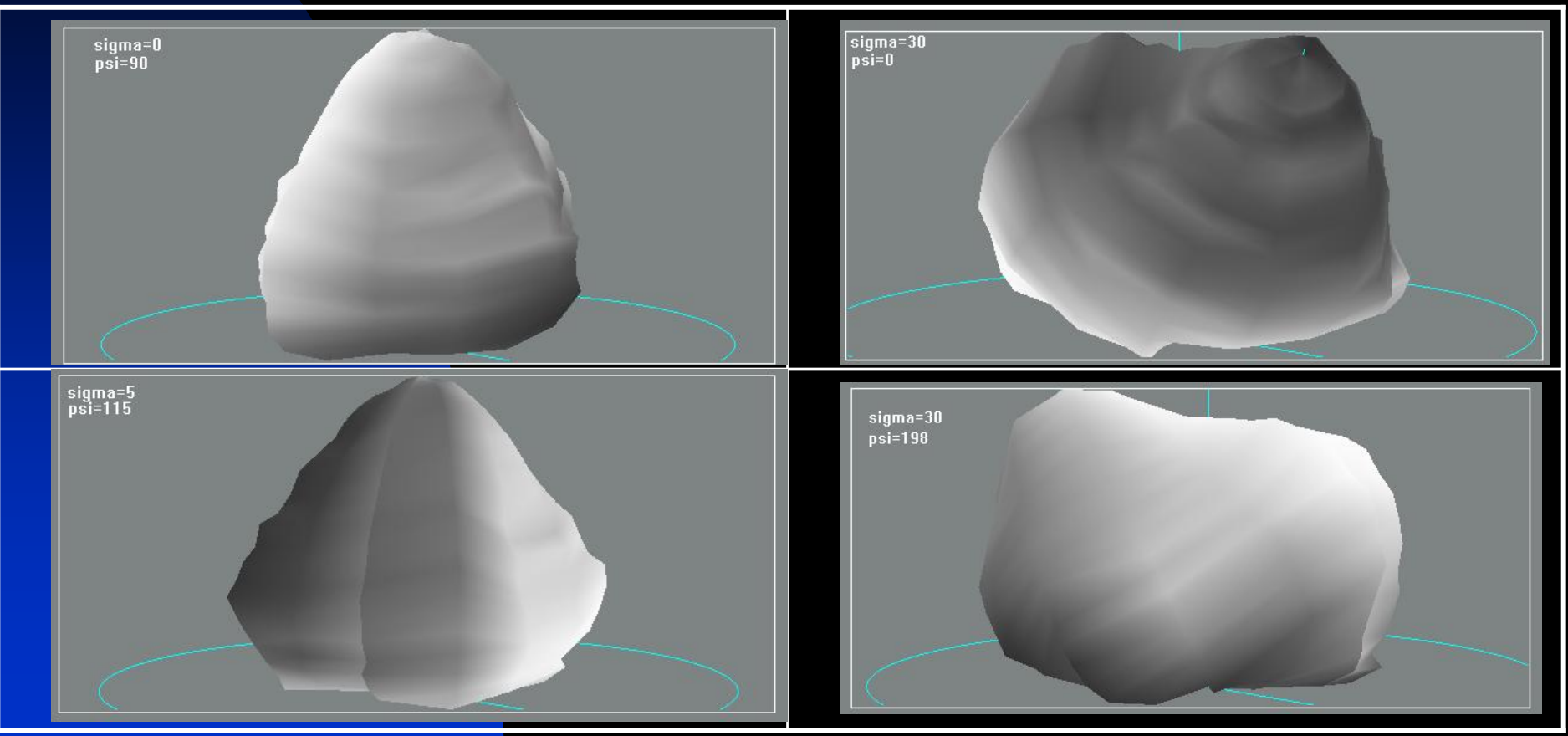
Distribution Calculator

- $f(p, x) = f_v(p)$



- $f_v(p) = \sum_{p': |p' \times p| \le \sin \omega} I_{p',\omega} \, [2\pi (1-\cos \omega) V]^{-1}$

Cloth BSDF cross-sections



Two chairs