Philips - A New Ray Tracing Method for Non-Imaging Optics

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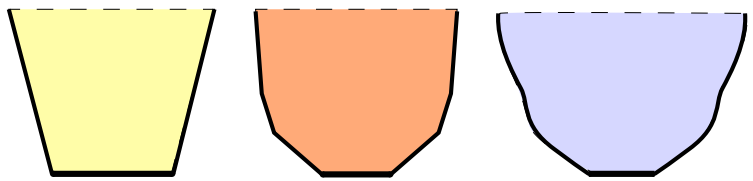
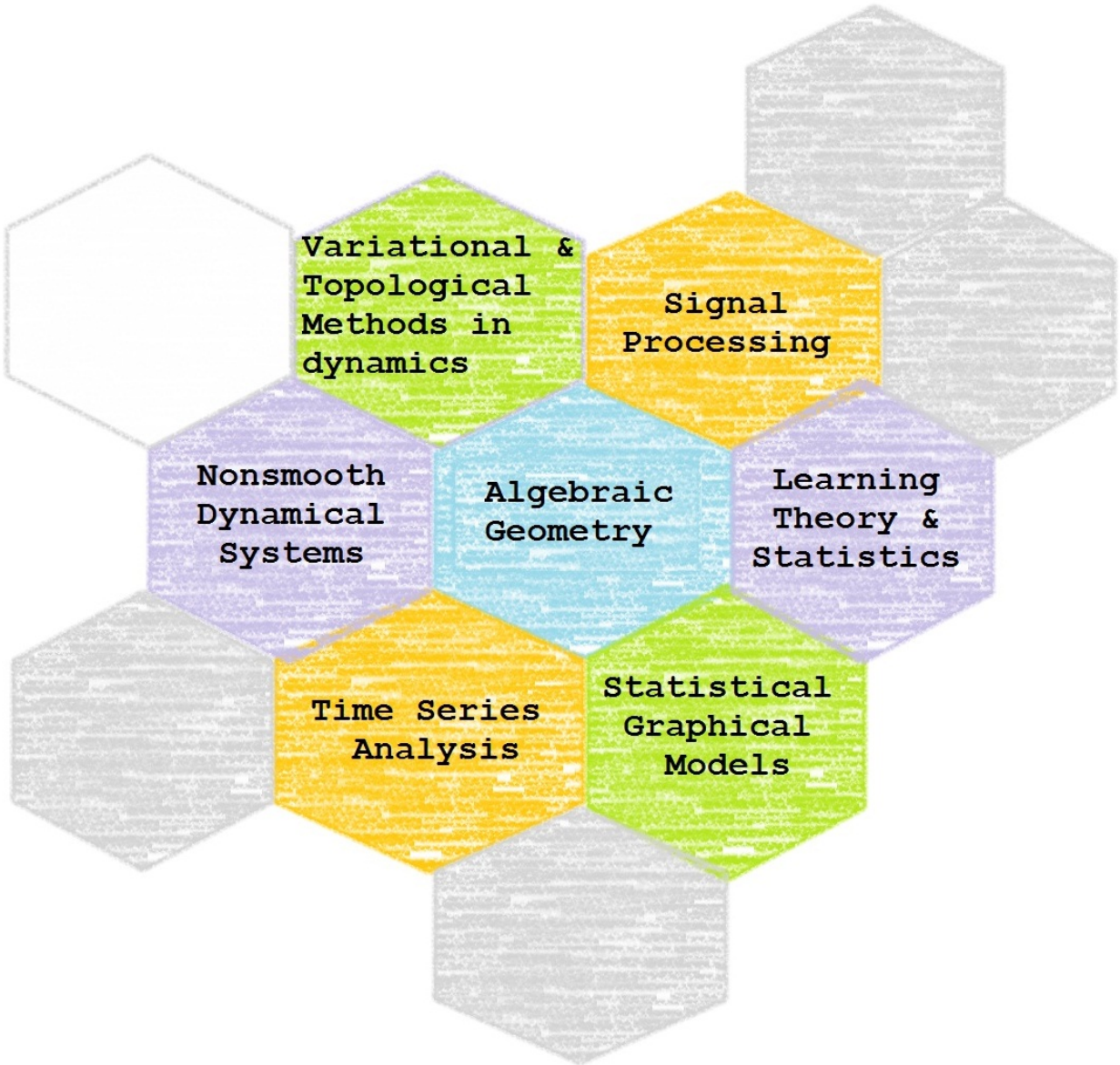
Study Group with Industry Eindhoven 2012

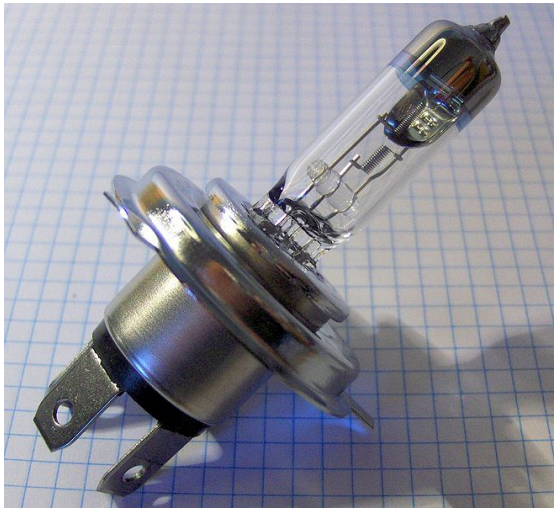
Japanese Mathematical Forum, July 19, 2012



PhD students, Post docs, Lecturers & Professors



Philips Lighting



http://commons.wikimedia.org/wiki/File:Philips_Xtreme_Power_headlight_bulb.JPG
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http://commons.wikimedia.org/wiki/File:Laparoscopic_stomach_surgery.jpg
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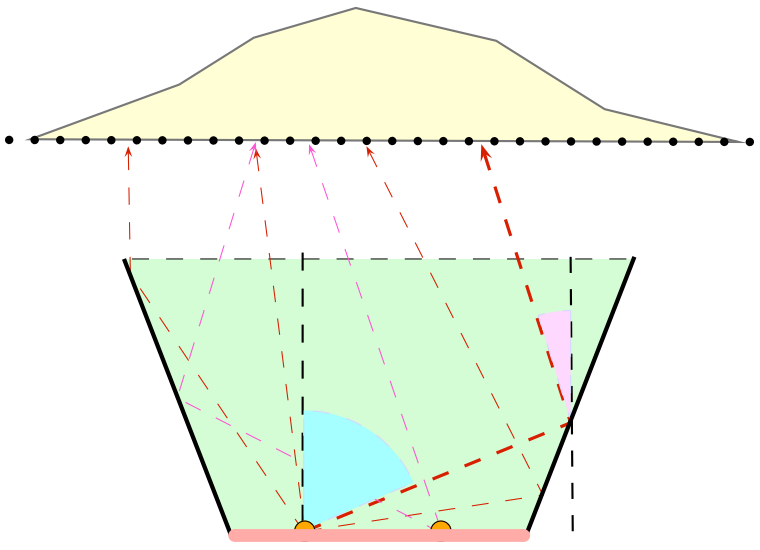
Optical Systems Design: Open Questions



Philips approach: Monte Carlo Method

Extensions to $3D$

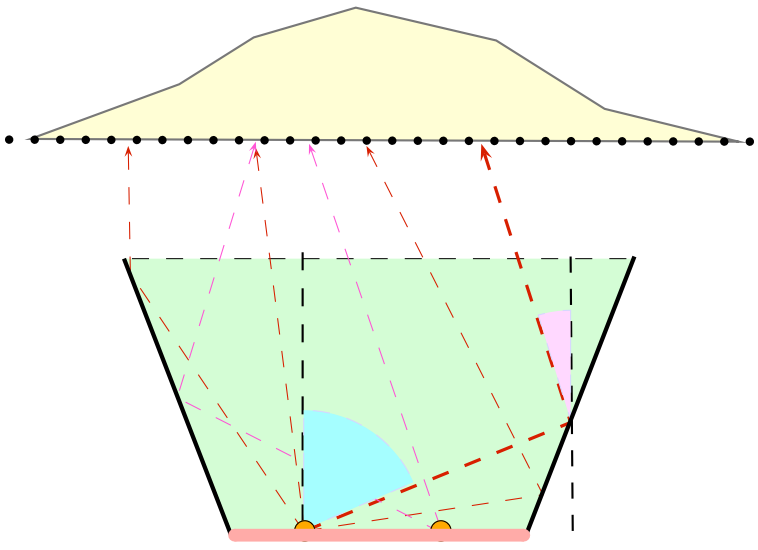
Light Characteristics

- luminous intensity
- colour point
- brightness

Finite or far field

Fixture characteristics

- lenses
- mirrors
- shape



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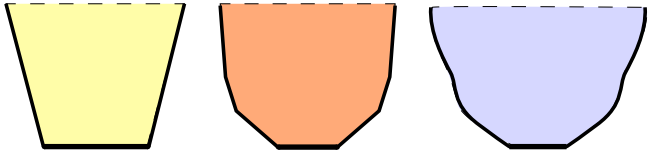
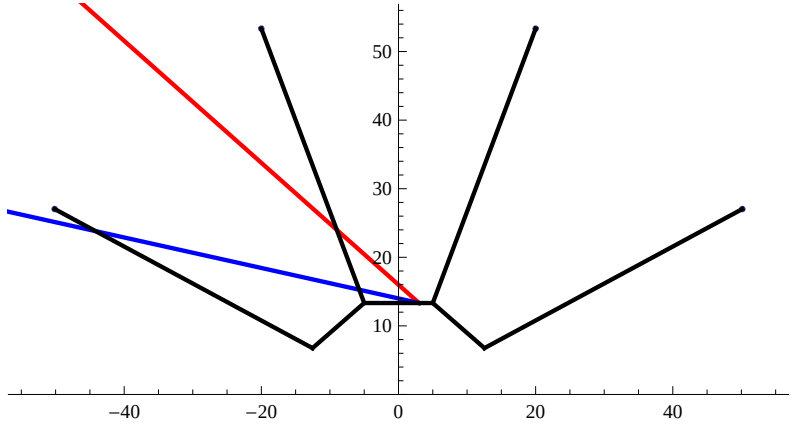


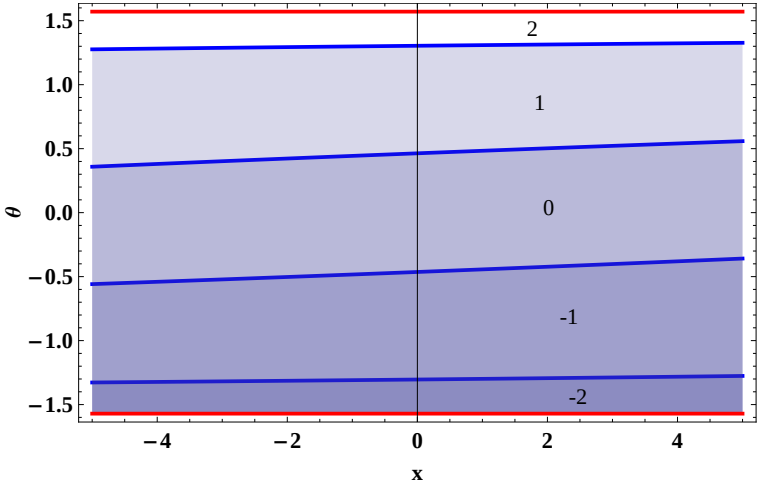
Two-Faceted Cup

Analytical results

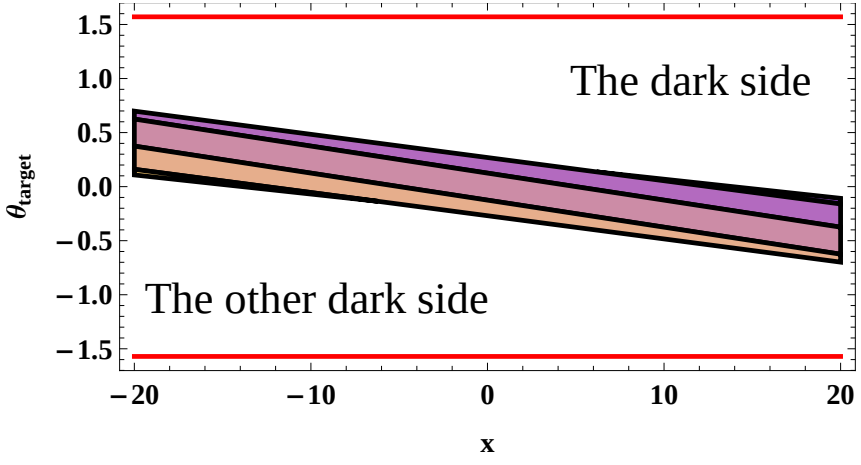
- $\exists$ maximum number of reflections n
- $\tan(\theta) = C_1(n, par) - C_2(n, par)x$
- $(x_{target}, \theta_{target}) = f(x, \theta, n, par)$
- Philips example:



Source:

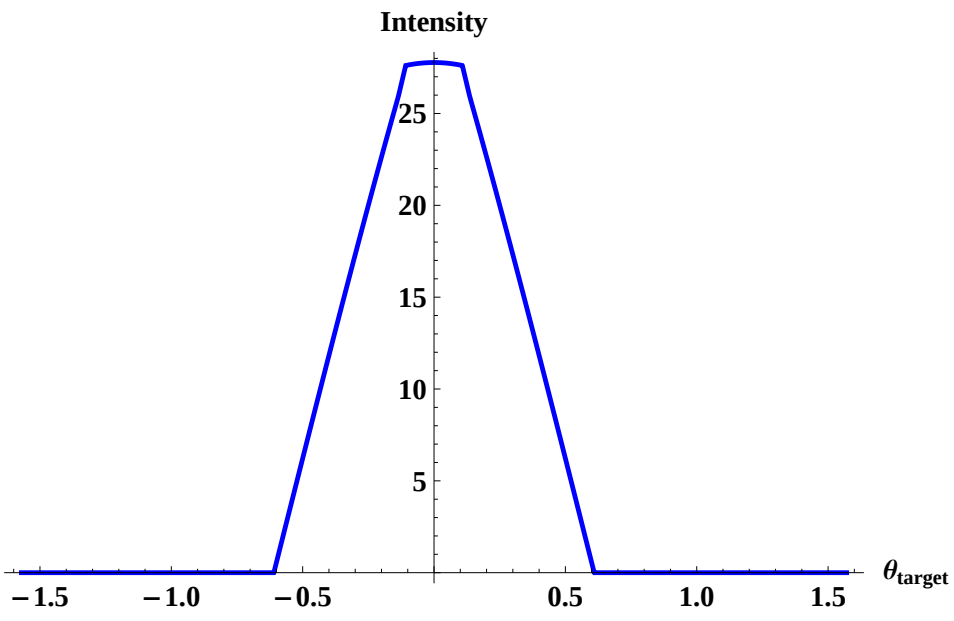


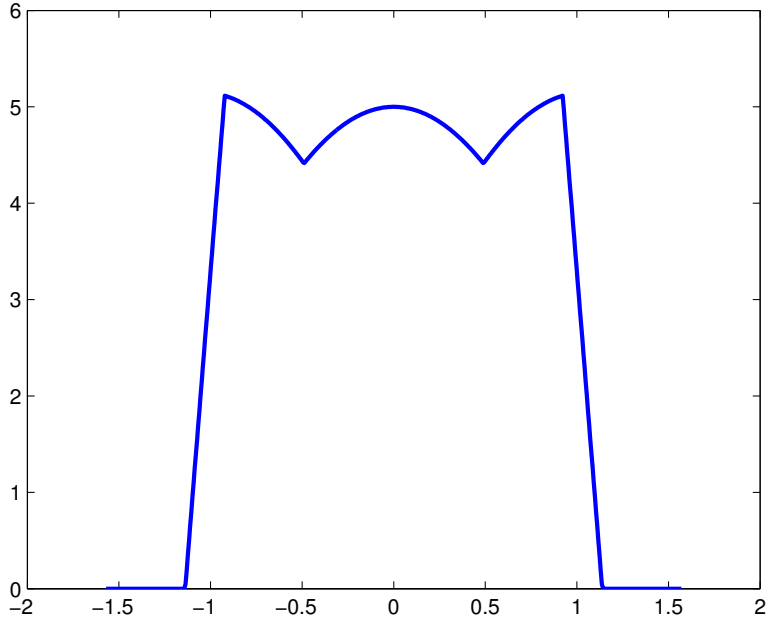
Target:



Light Intensity

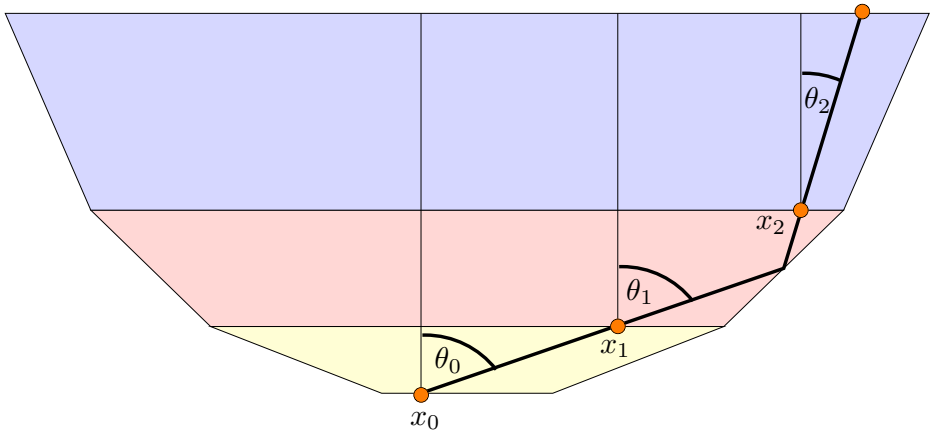
$I_{\text{source}} \sim \cos\theta$ (Lambertian)

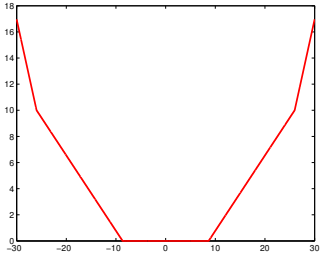


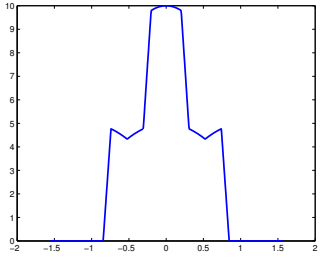


Varying cup parameters.

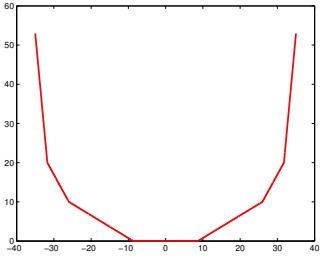
Intensity for multi-faceted cups

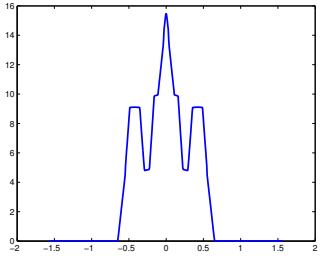






4-faceted Fixture





6-faceted Fixture

In one week

- For axis-symmetric 2-facet cups:
  - Formulas for the boundaries of the source and target phase spaces were derived
  - Implemented in Mathematica
- For axis-symmetric multifaceted cups:
  - Explicit formulas for the intensity function on the far field were derived
  - Implemented in Mathematica
- For arbitrary smooth cups:
  - A deterministic algorithm for numerical approximation of the division of source phase space (with exponential order convergence) was written
  - MC algorithm for integration over the source phase space, using bootstrapping, was constructed
  - Implemented in Matlab