

Hybride kd-bomen voor photonmapping en het versnellen van ray tracing

Matthias Moulin



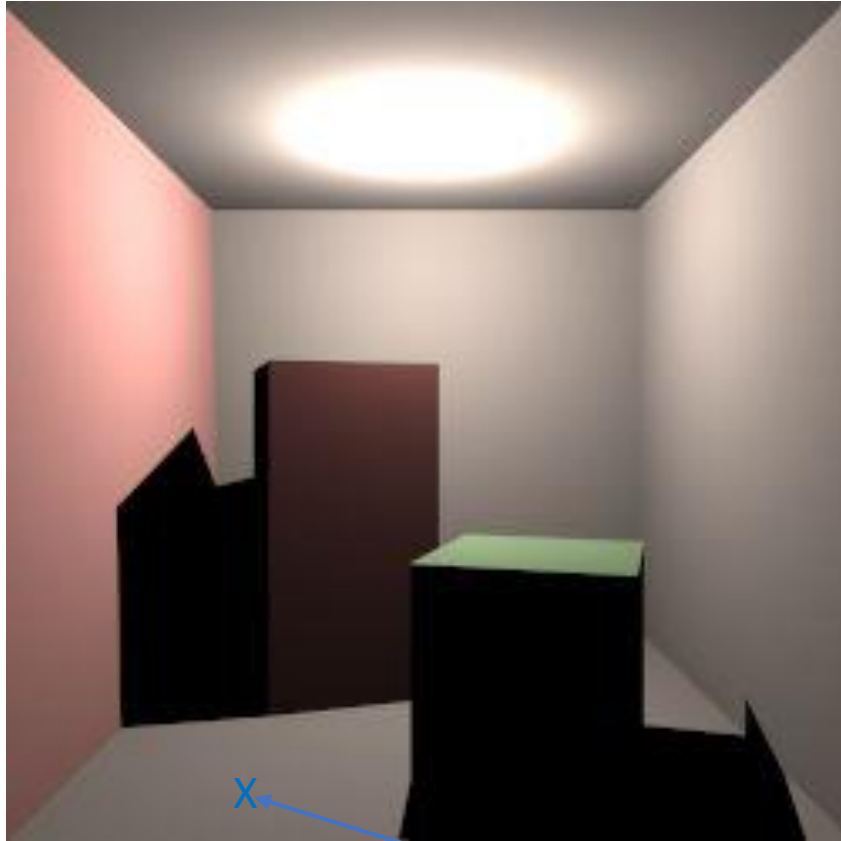
Ray tracing



Ray tracing



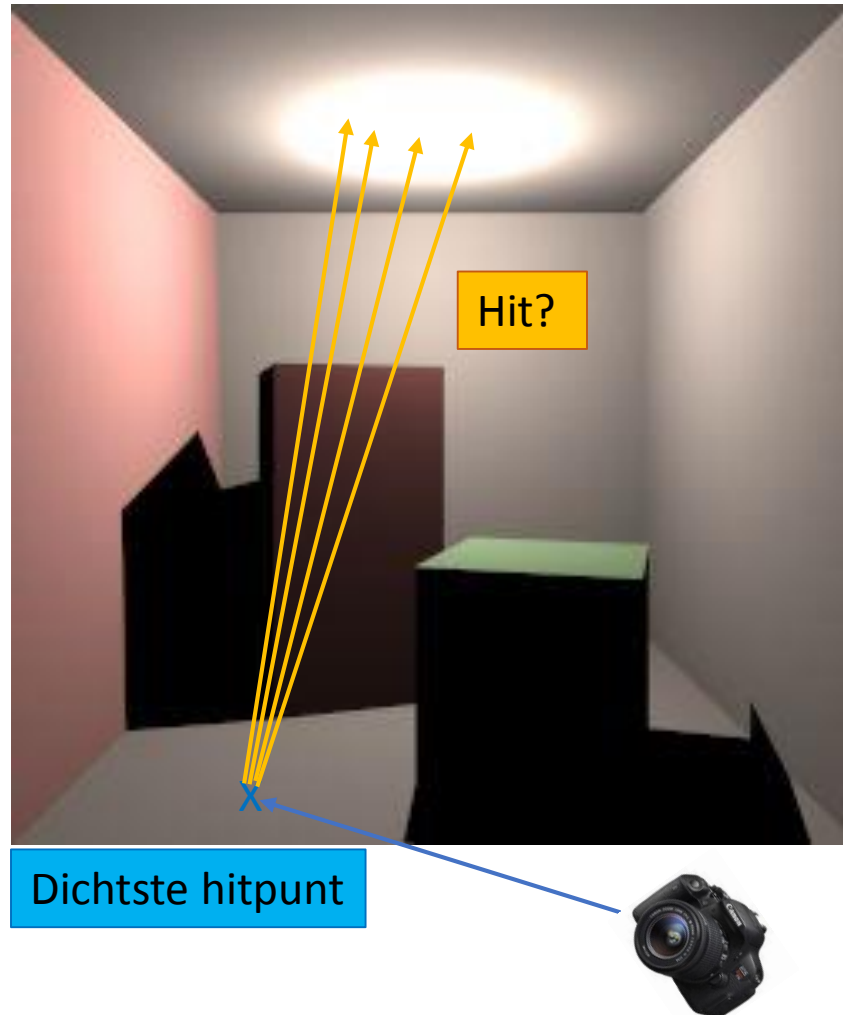
Ray tracing



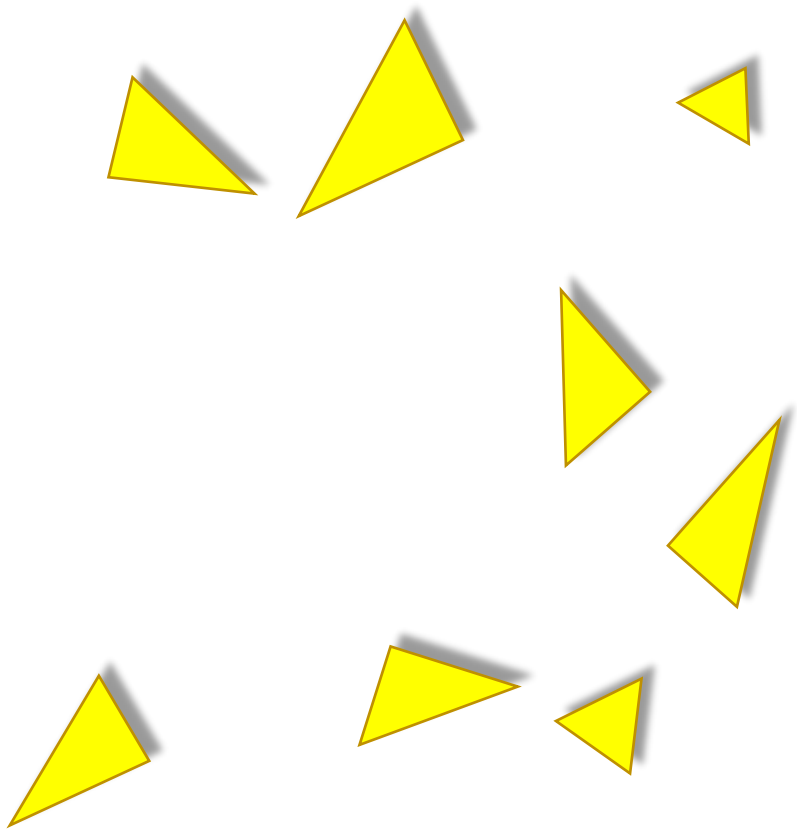
Dichtste hitpunt



Ray tracing

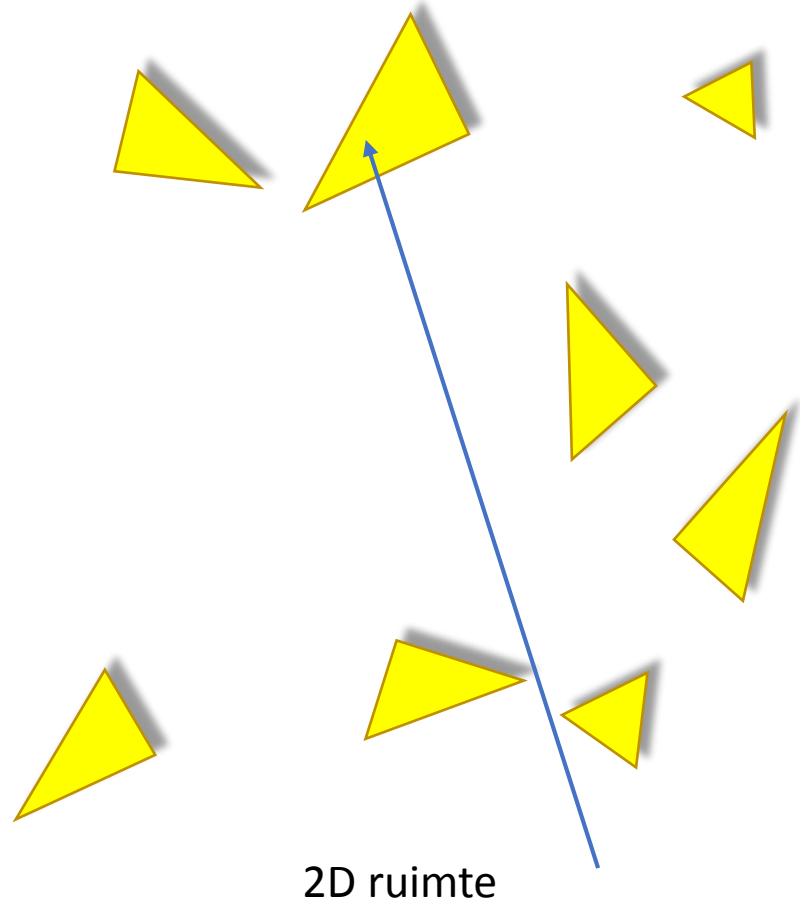


Acceleratiestructuren – kd-bomen

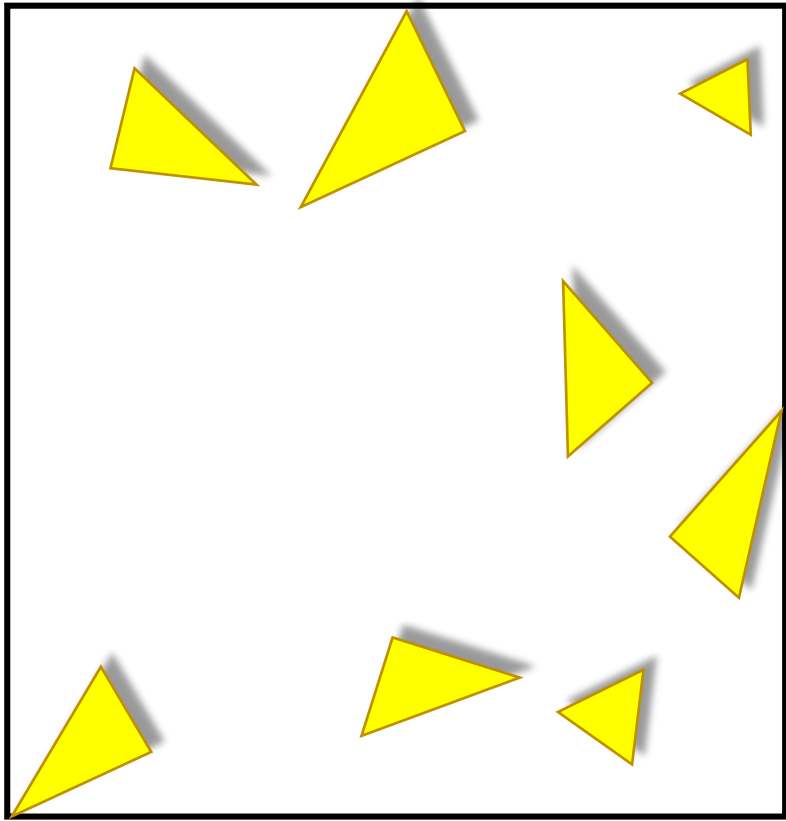


2D ruimte

Acceleratiestructuren – kd-bomen



Acceleratiestructuren – kd-bomen



2D ruimte

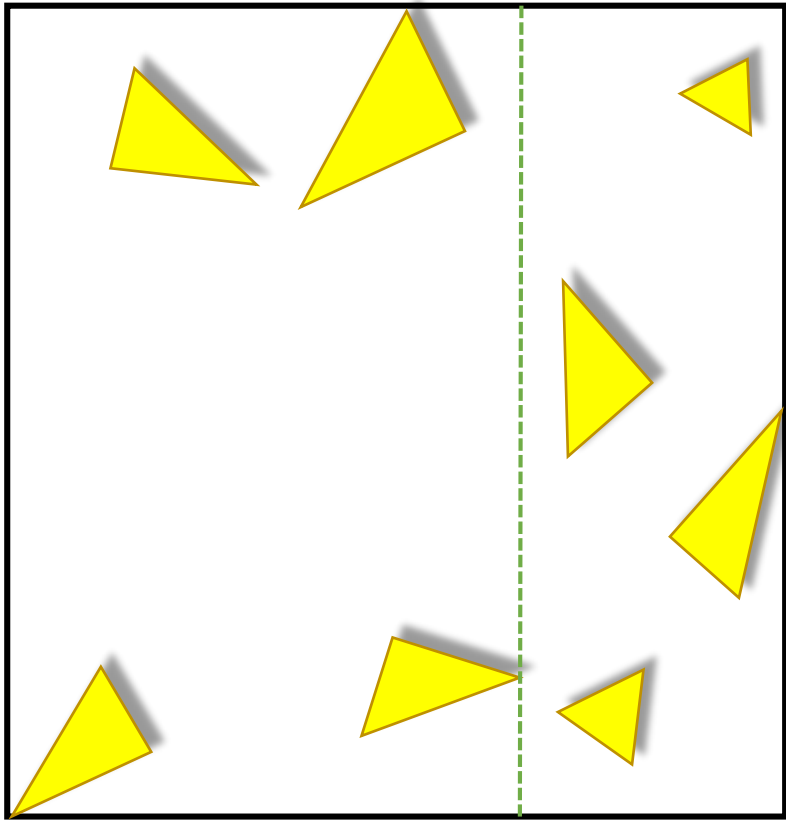
Kd-boom

Opsplitsingsheuristiek

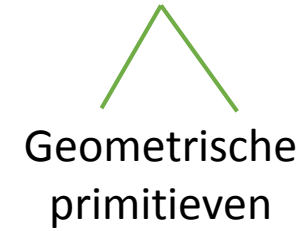
- Surface Area Heuristic (SAH)

[Goldsmith & Salmon 1987], [MacDonald & Booth 1990]

Acceleratiestructuren – kd-bomen

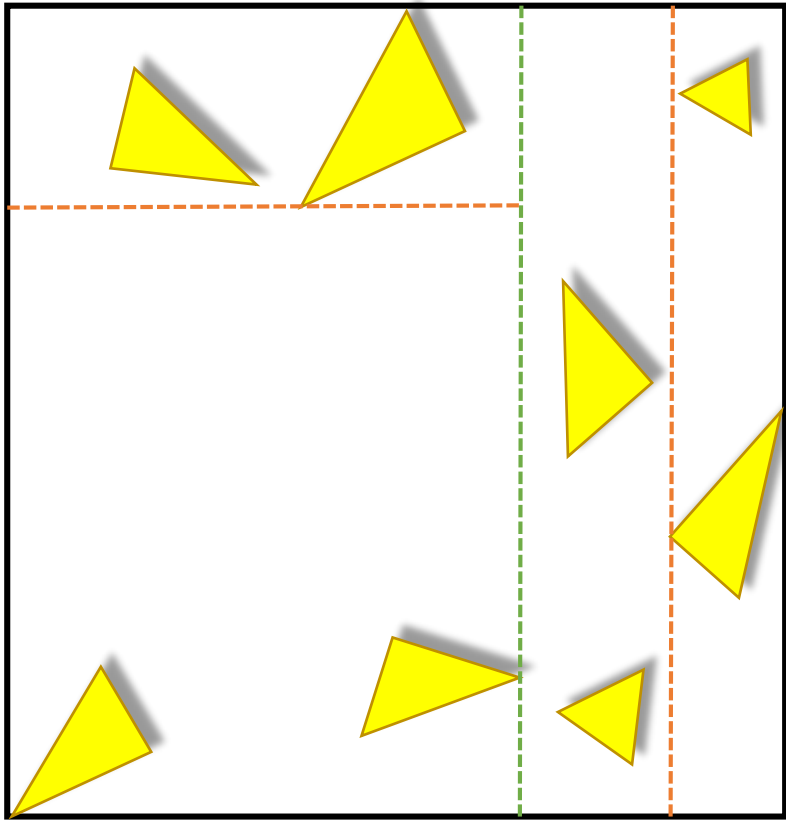


2D ruimte



kd-boom datastructuur

Acceleratiestructuren – kd-bomen

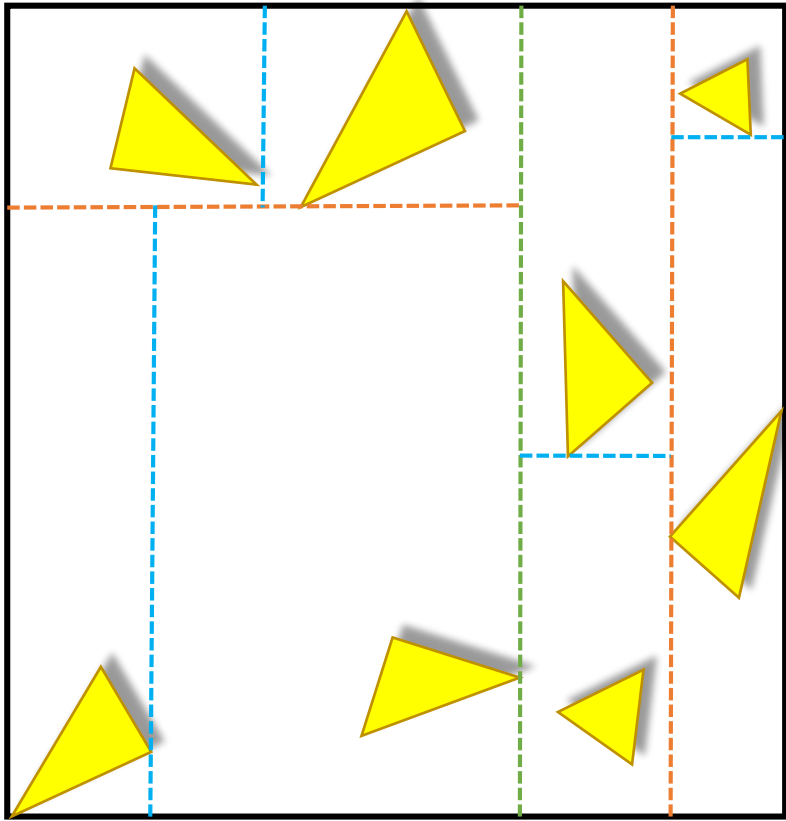


2D ruimte

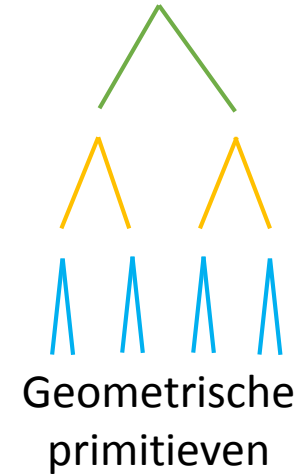


kd-boom datastructuur

Acceleratiestructuren – kd-bomen

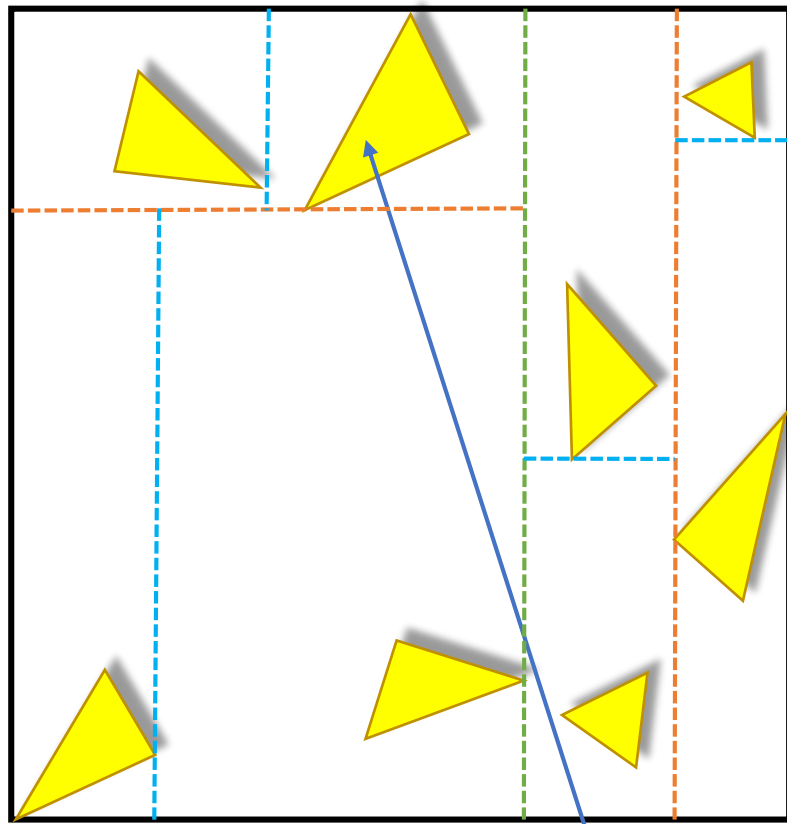


2D ruimte



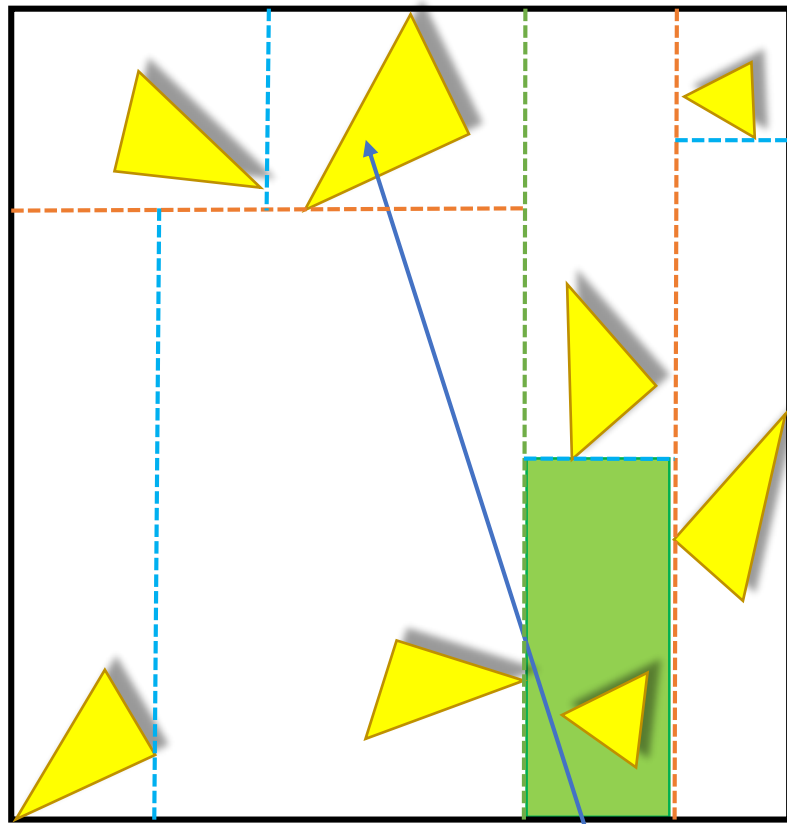
kd-boom datastructuur

Acceleratiestructuren – kd-bomen



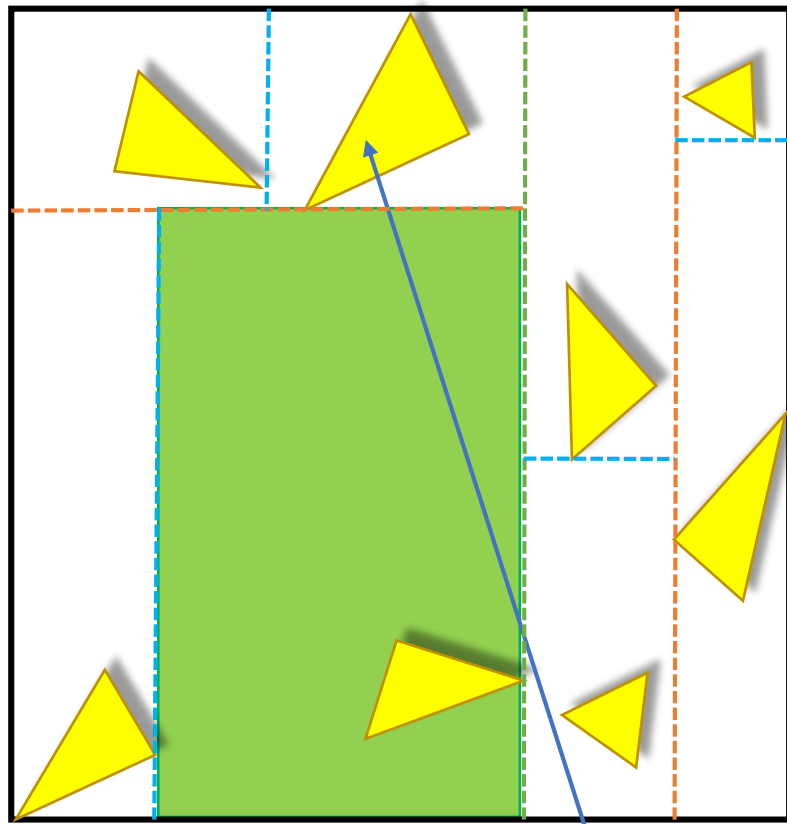
2D ruimte

Acceleratiestructuren – kd-bomen



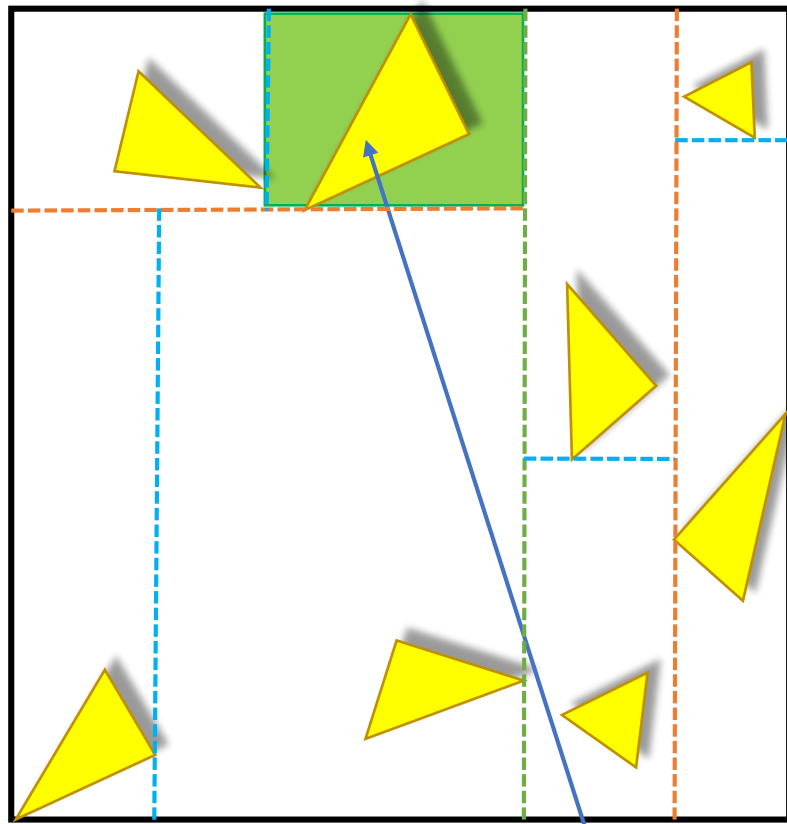
2D ruimte

Acceleratiestructuren – kd-bomen



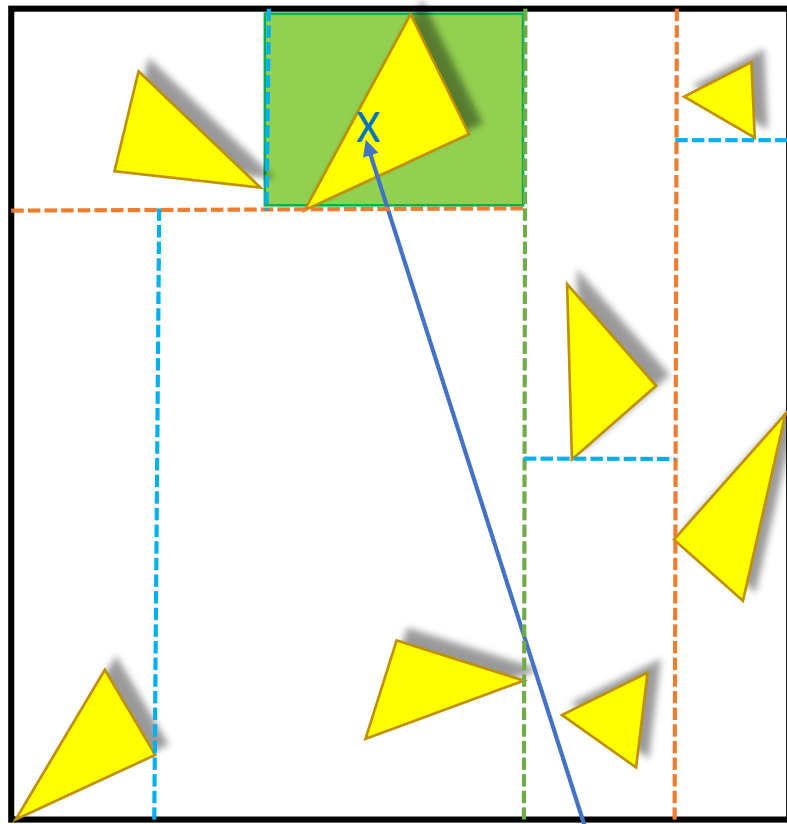
2D ruimte

Acceleratiestructuren – kd-bomen



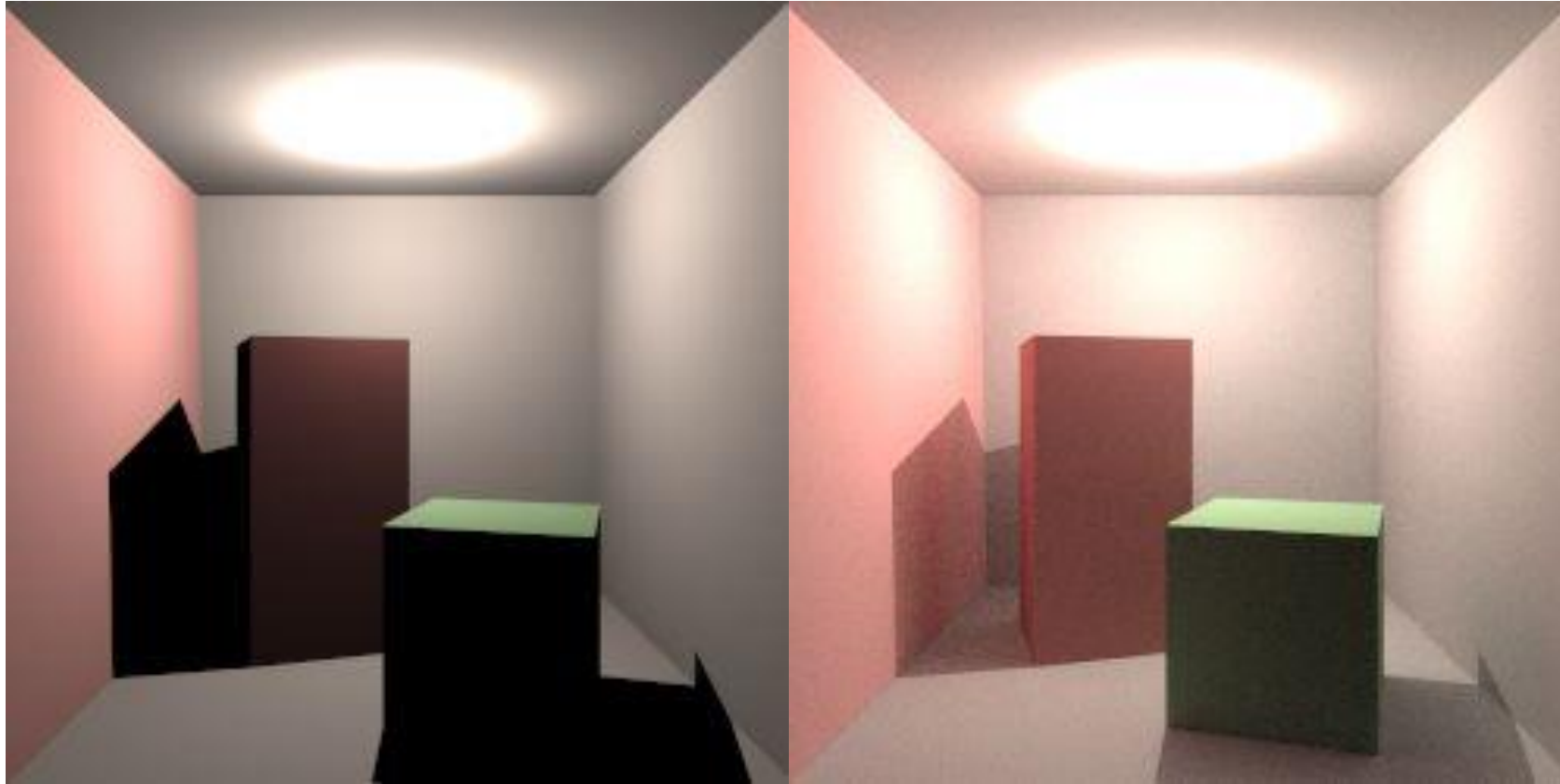
2D ruimte

Acceleratiestructuren – kd-bomen



2D ruimte

Globale belichting

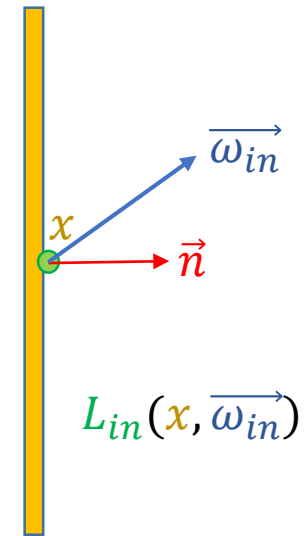
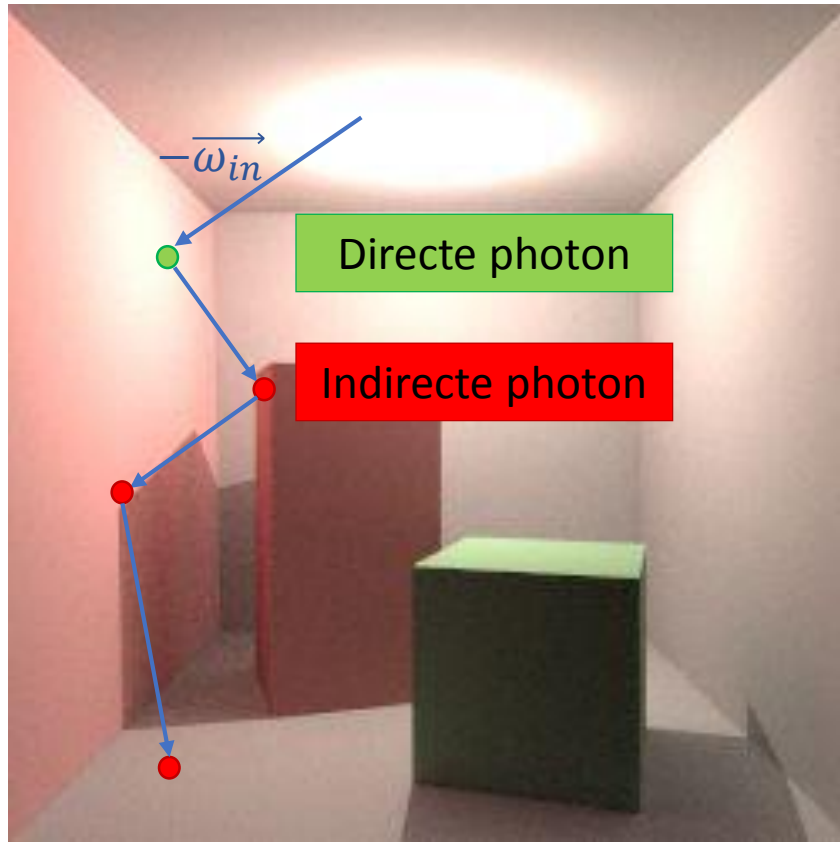


Directe belichting

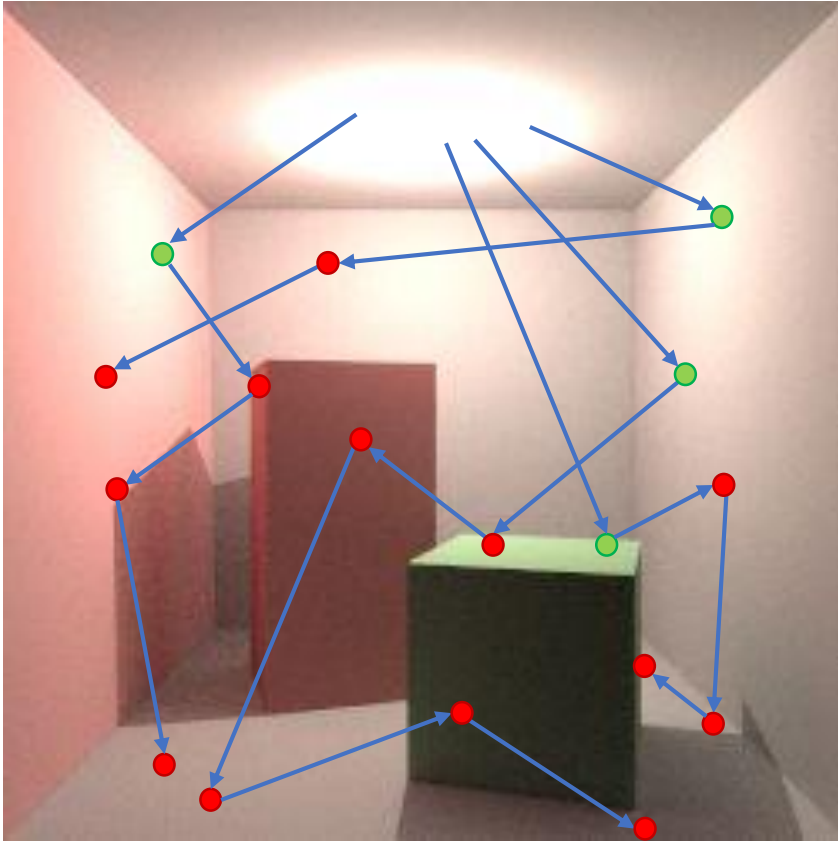
Directe + Indirecte belichting

Photonmapping [Jensen 1996]

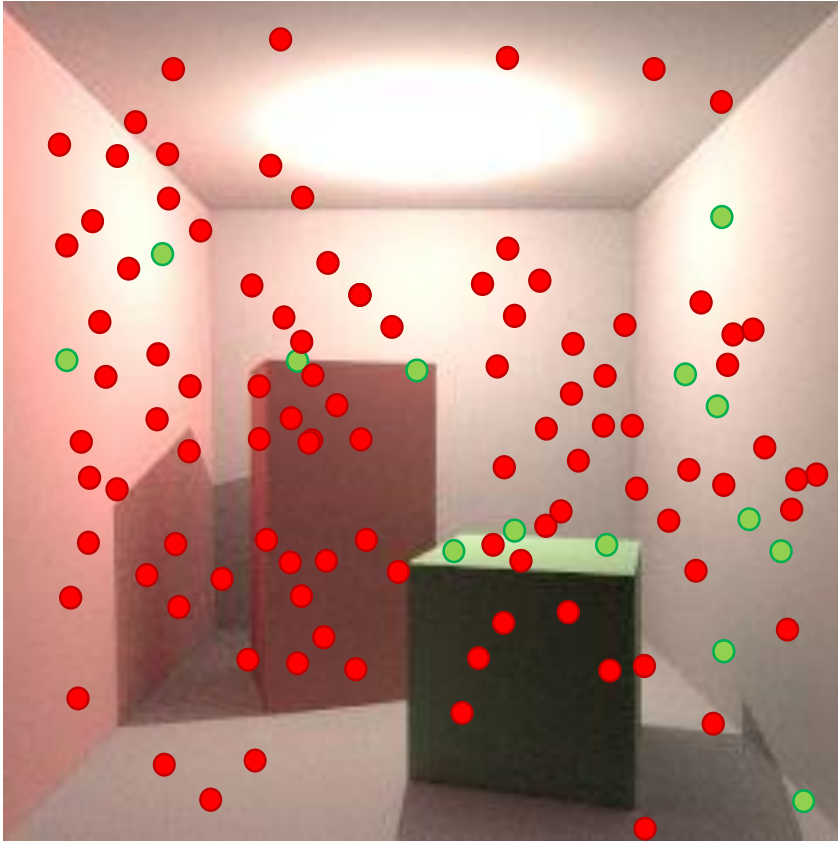
Photonmapping - Photontracing



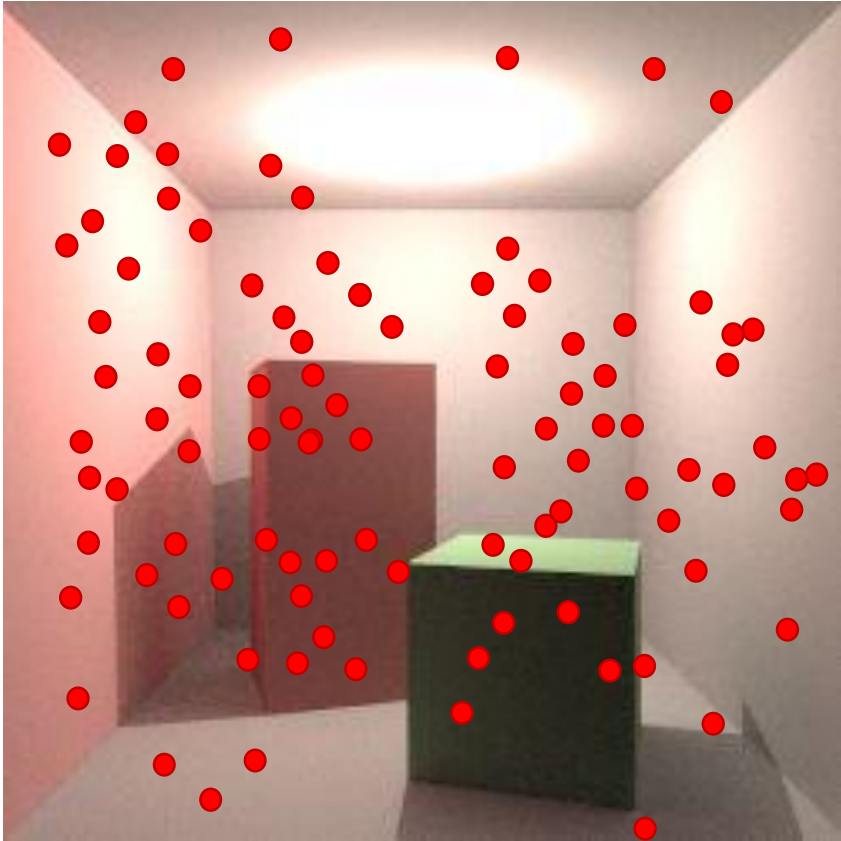
Photonmapping – Photon tracing



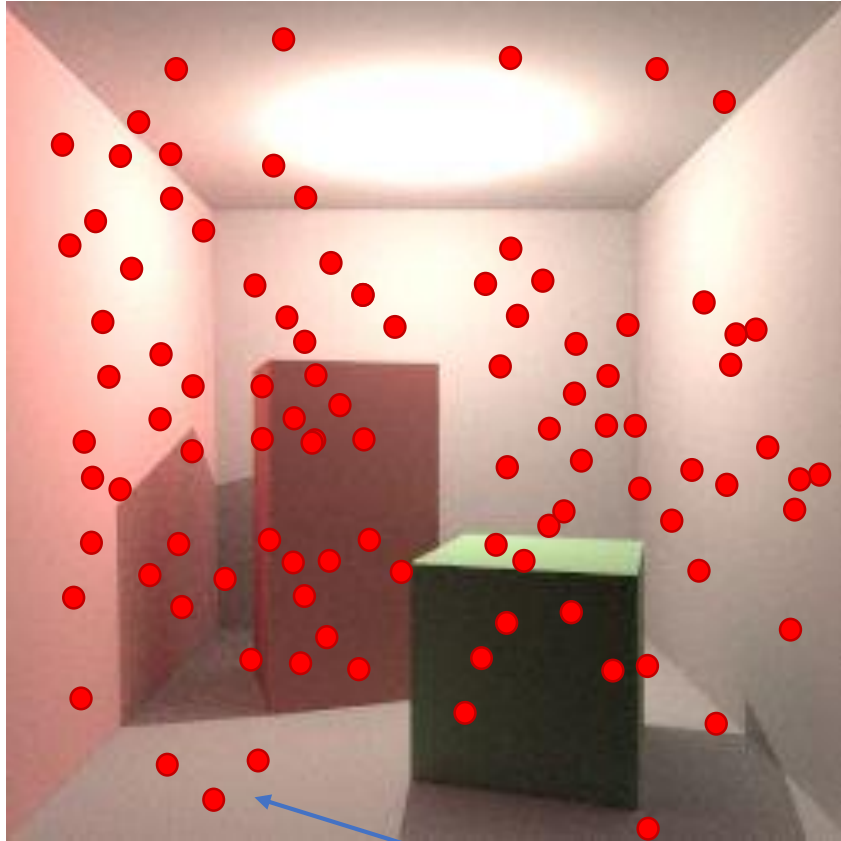
Photonmapping – Photon tracing



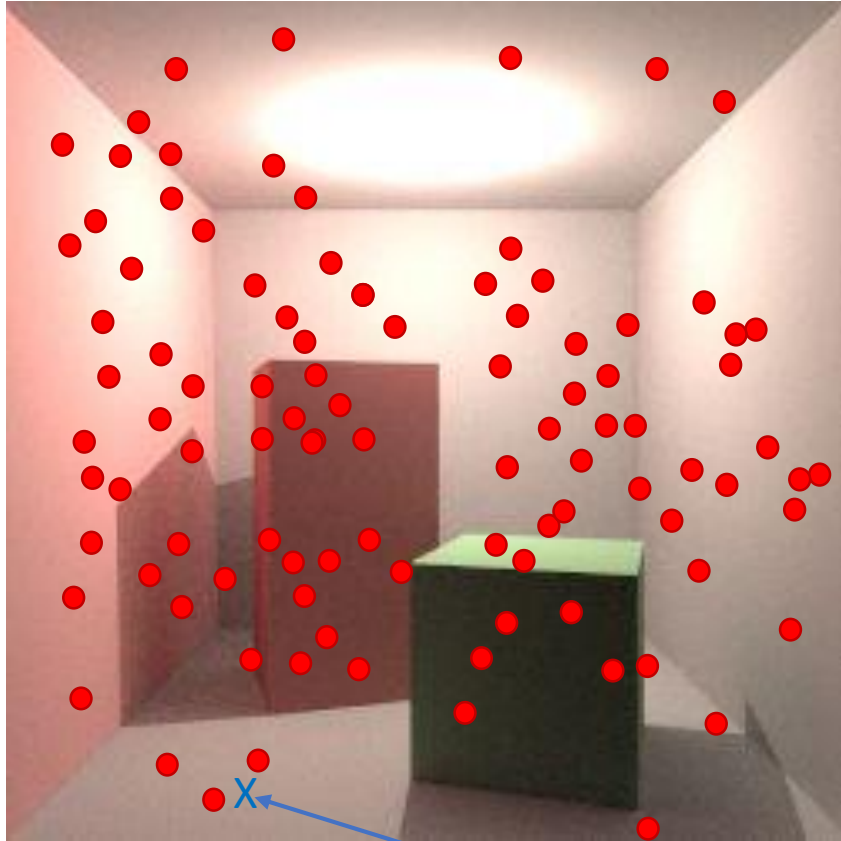
Photonmapping – Radiance estimate



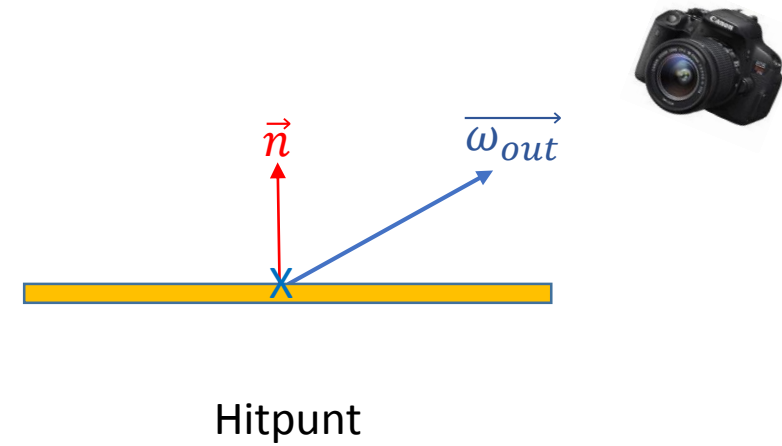
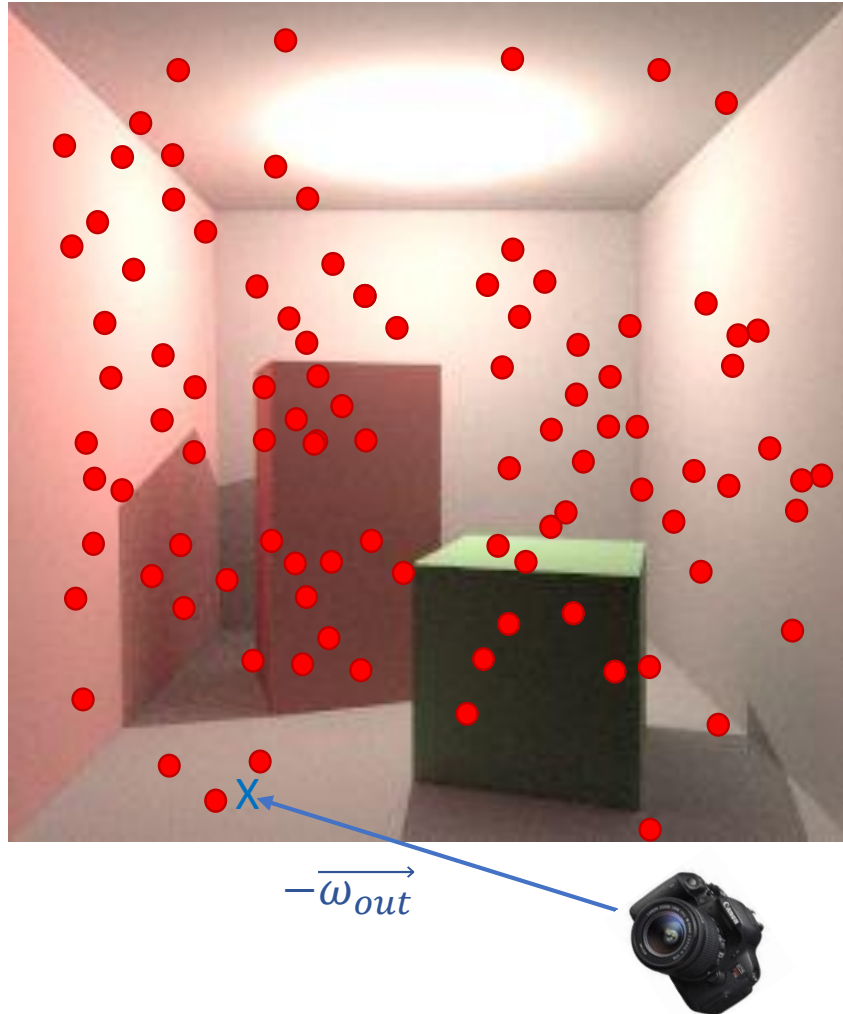
Photonmapping – Radiance estimate



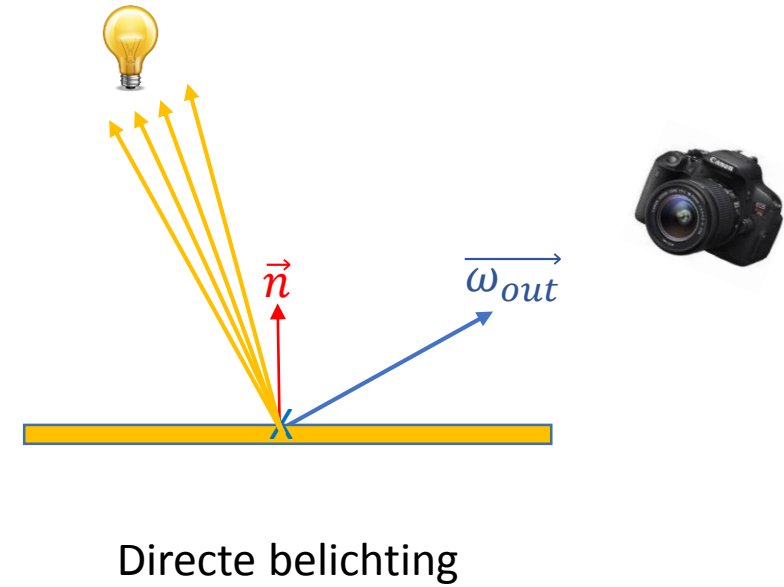
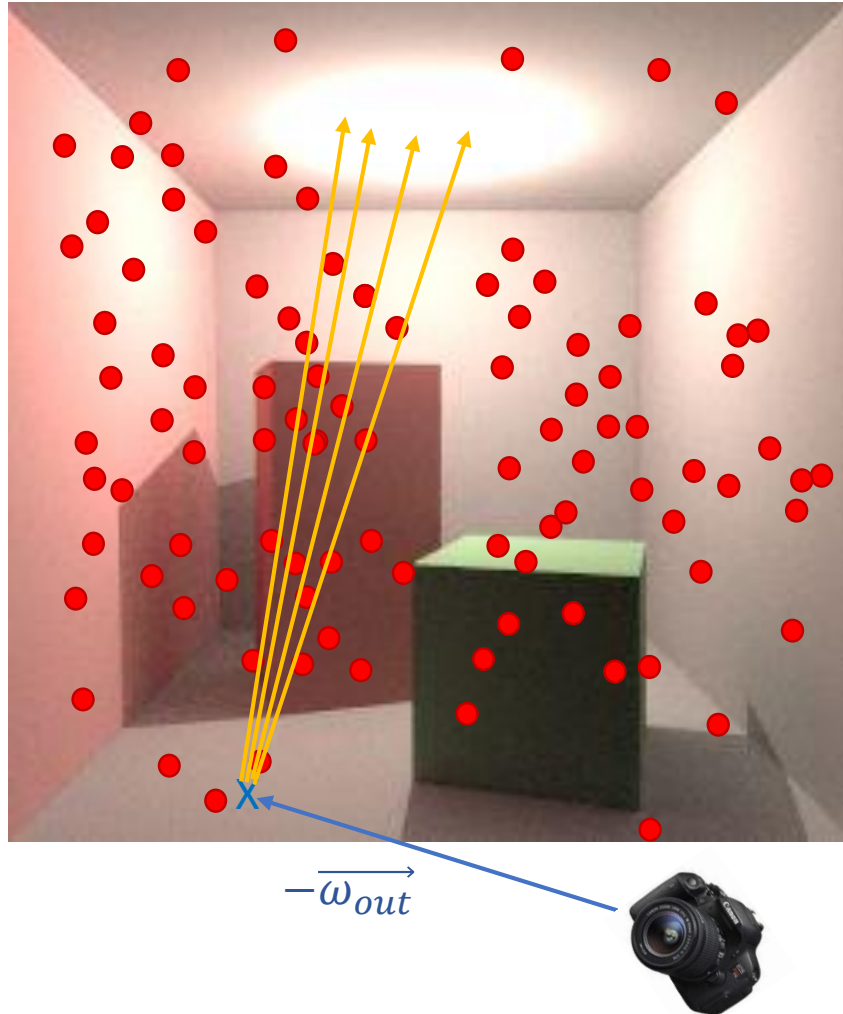
Photonmapping – Radiance estimate



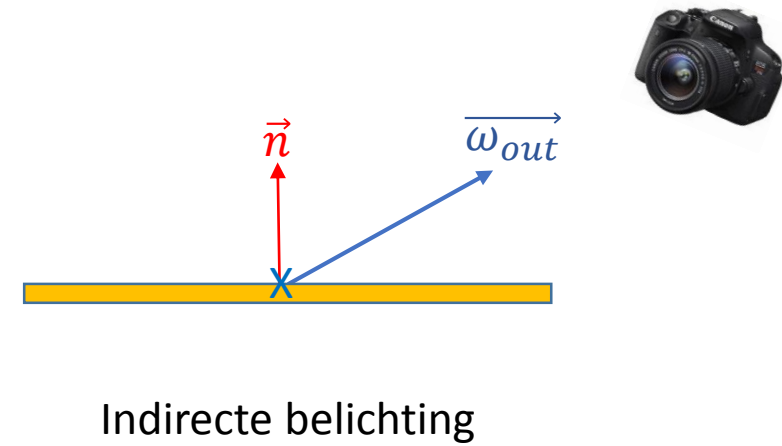
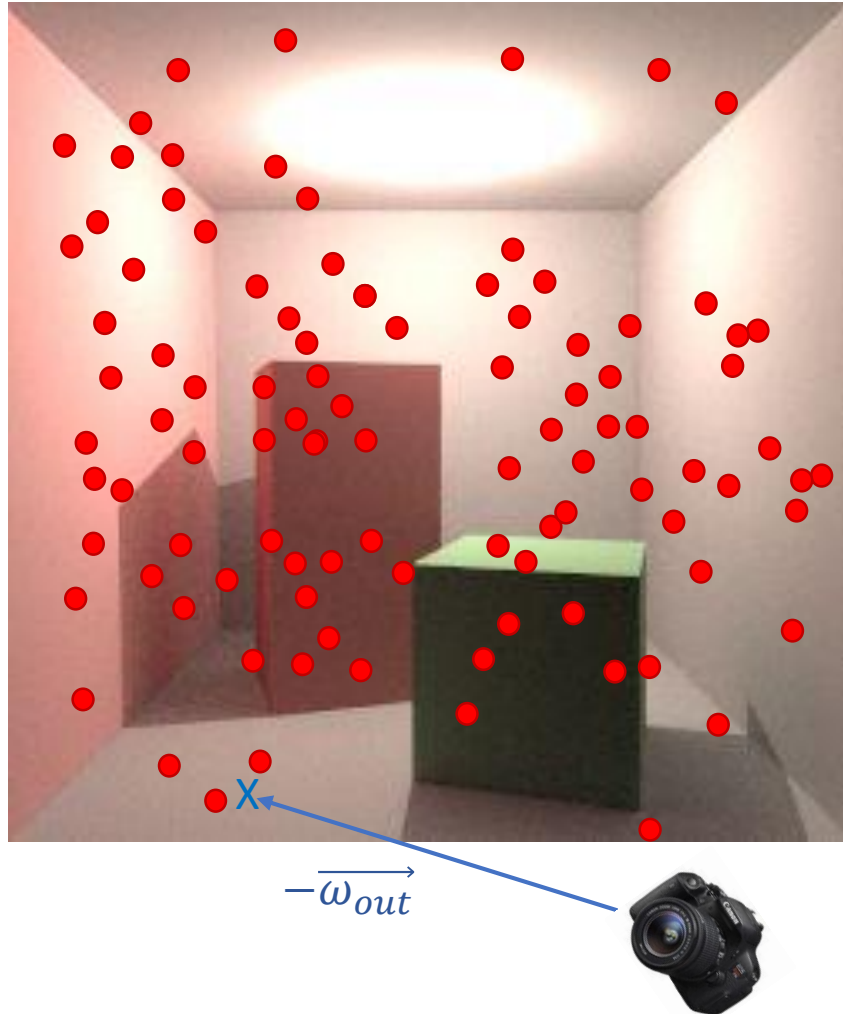
Photonmapping – Radiance estimate



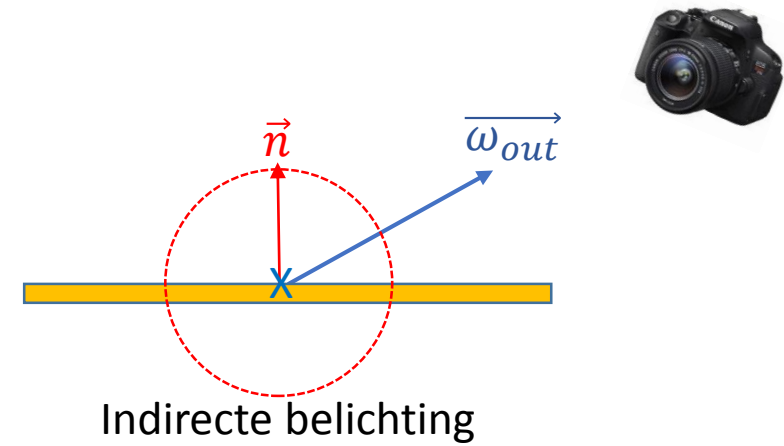
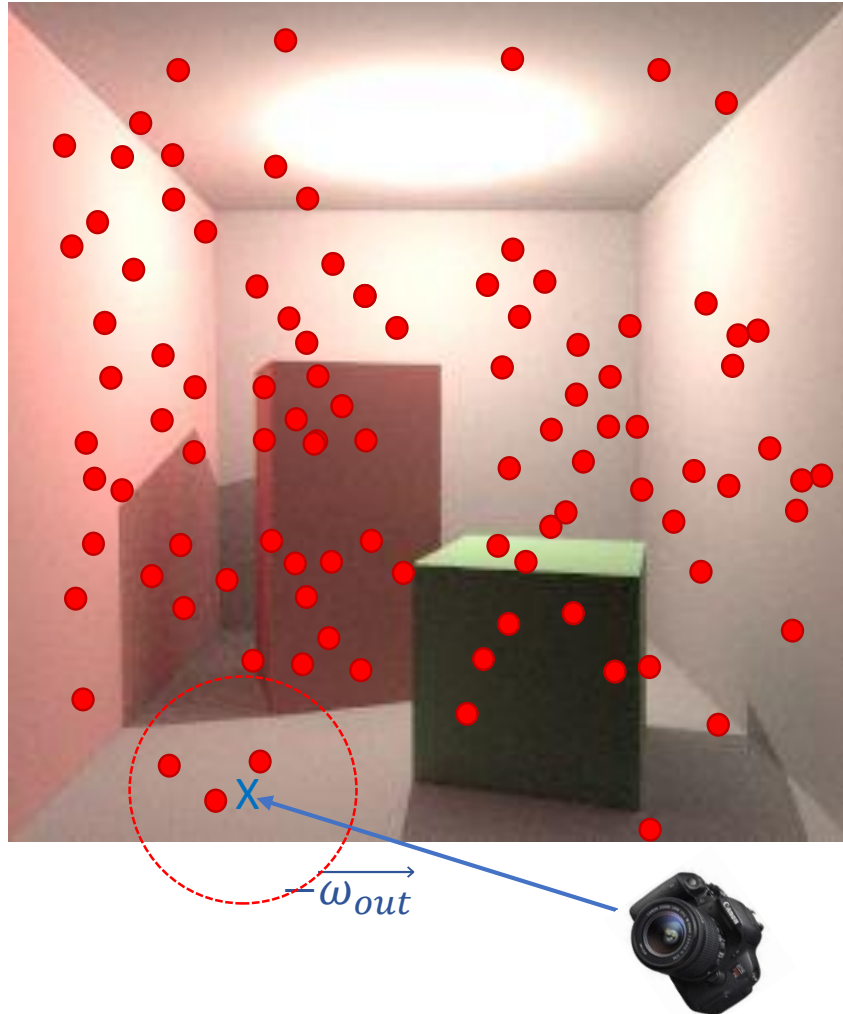
Photonmapping – Radiance estimate



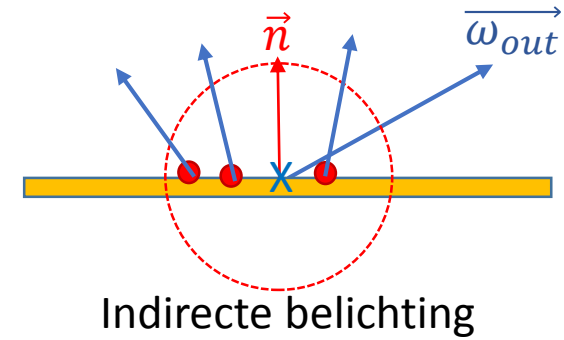
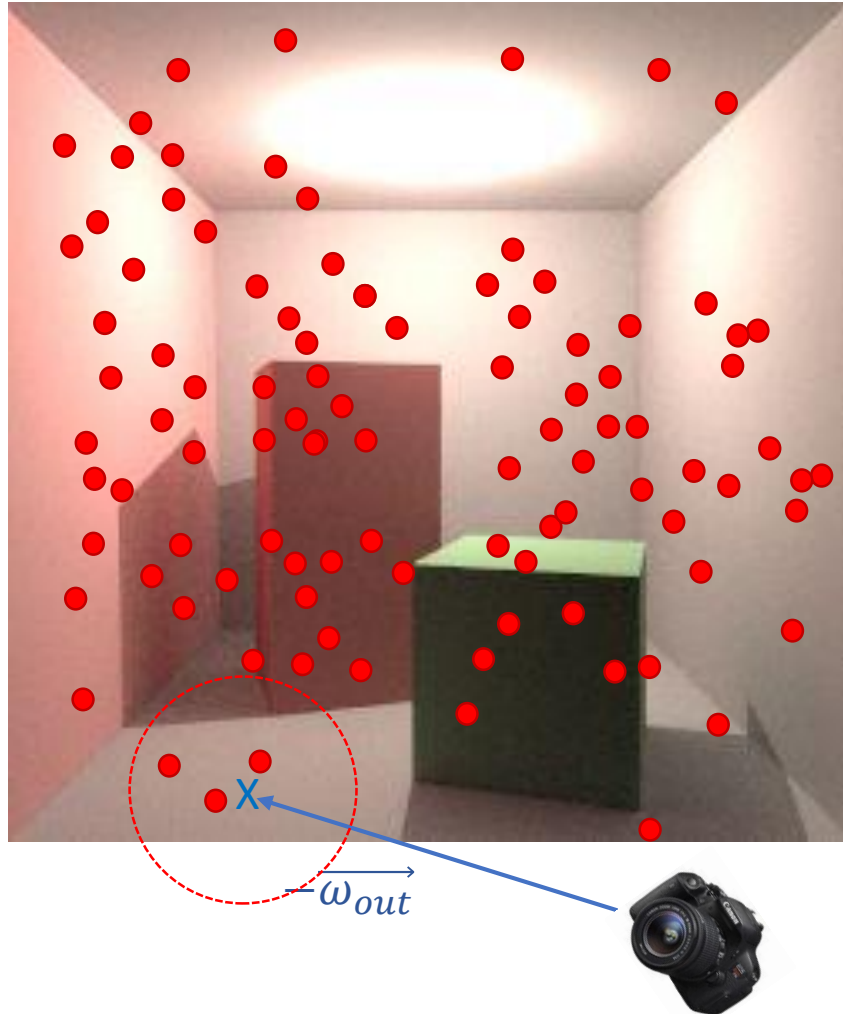
Photonmapping – Radiance estimate



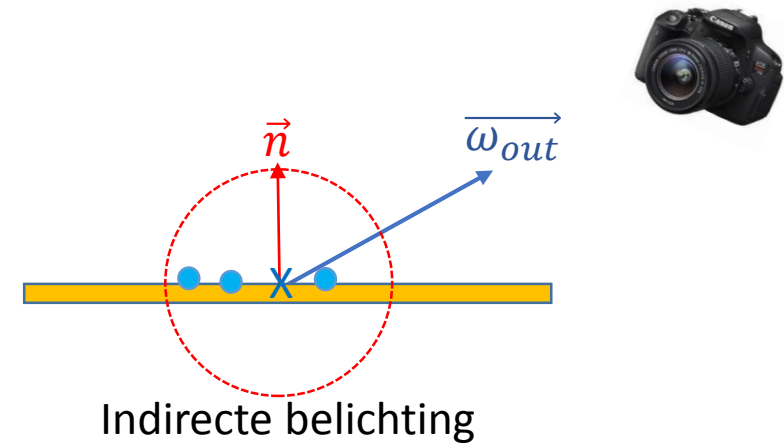
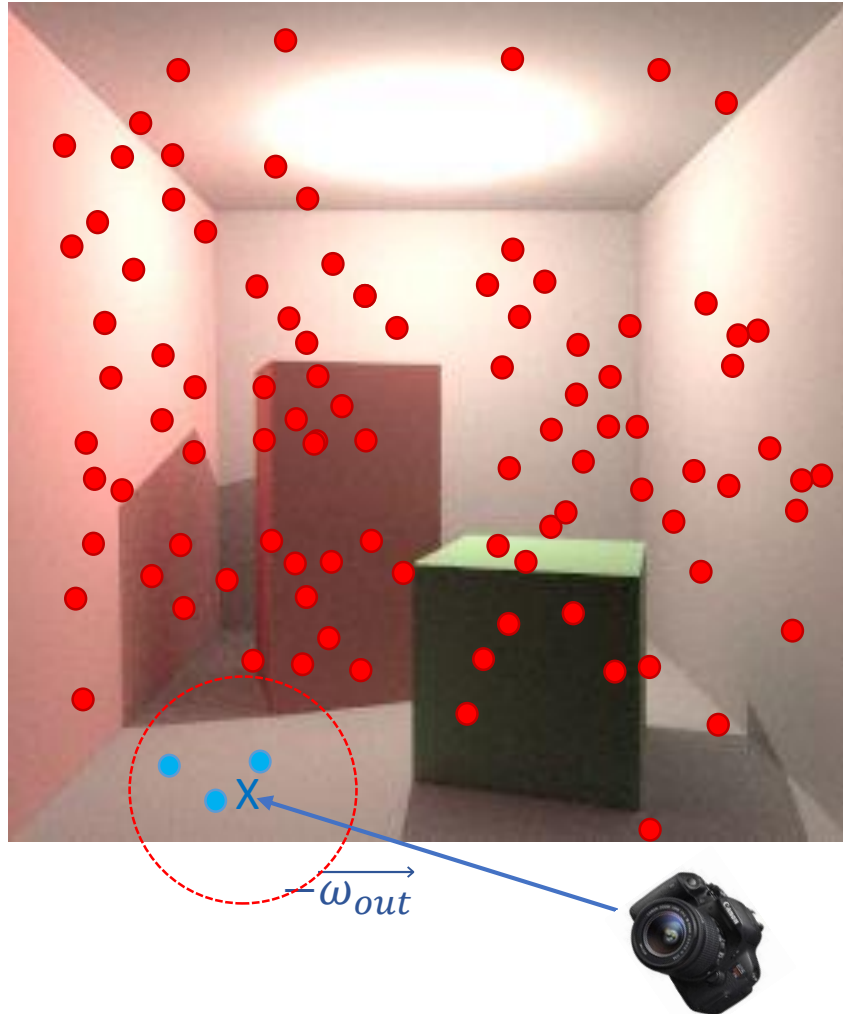
Photonmapping – Radiance estimate



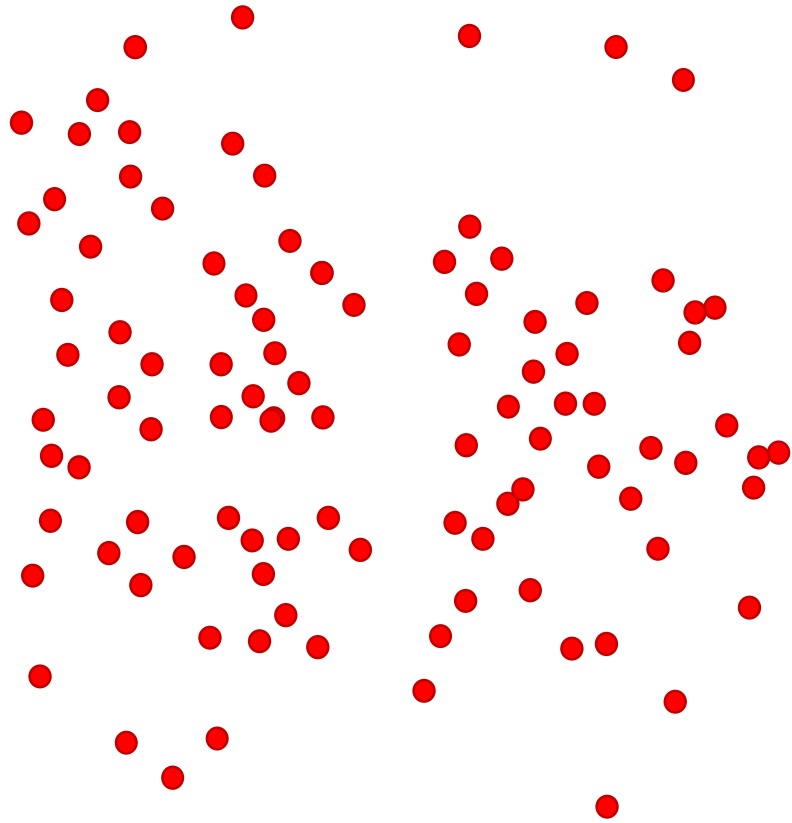
Photonmapping – Radiance estimate



Photonmapping – Radiance estimate

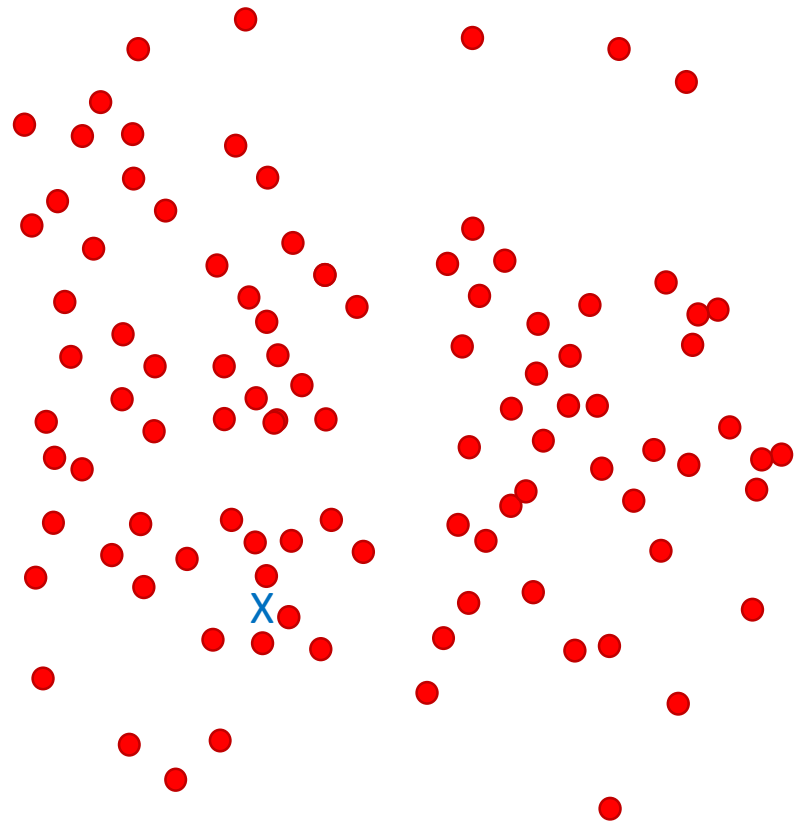


Photonmapping – Photonmap building



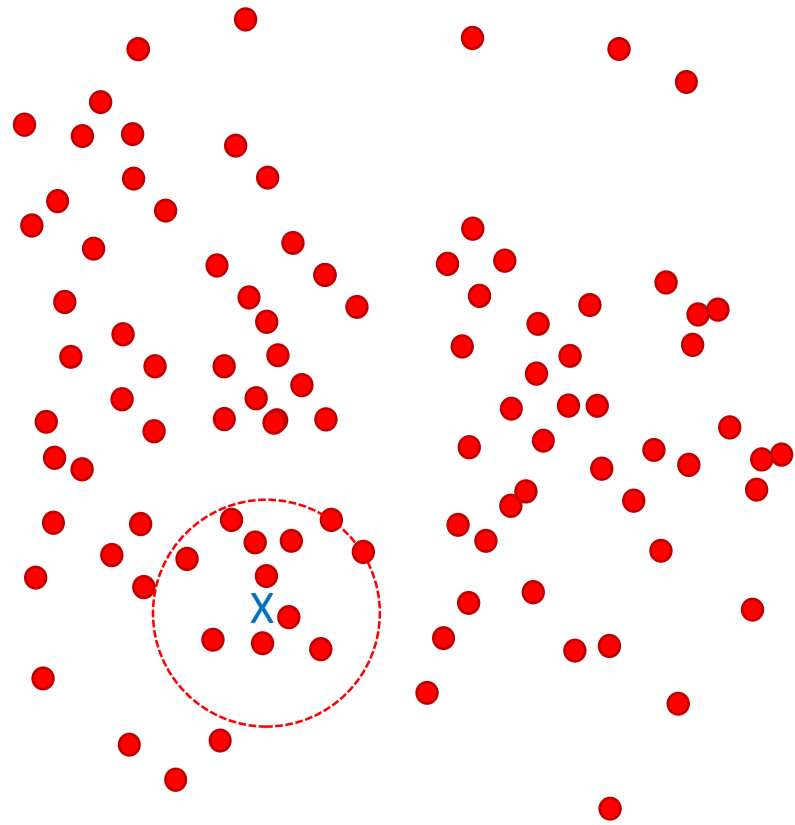
2D ruimte

Photonmapping – Photonmap building



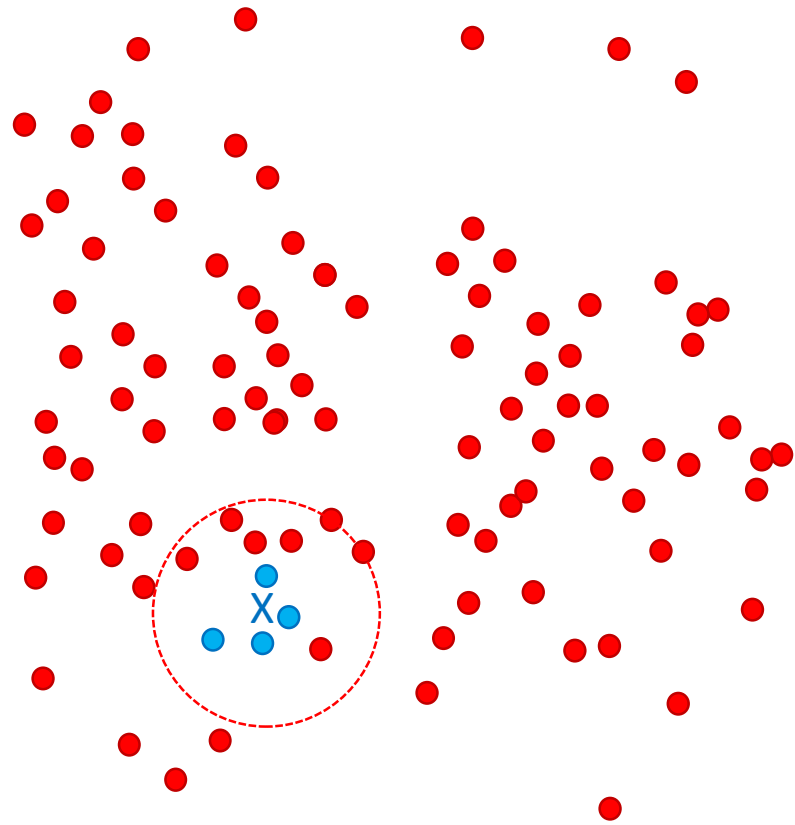
2D ruimte

Photonmapping – Photonmap building



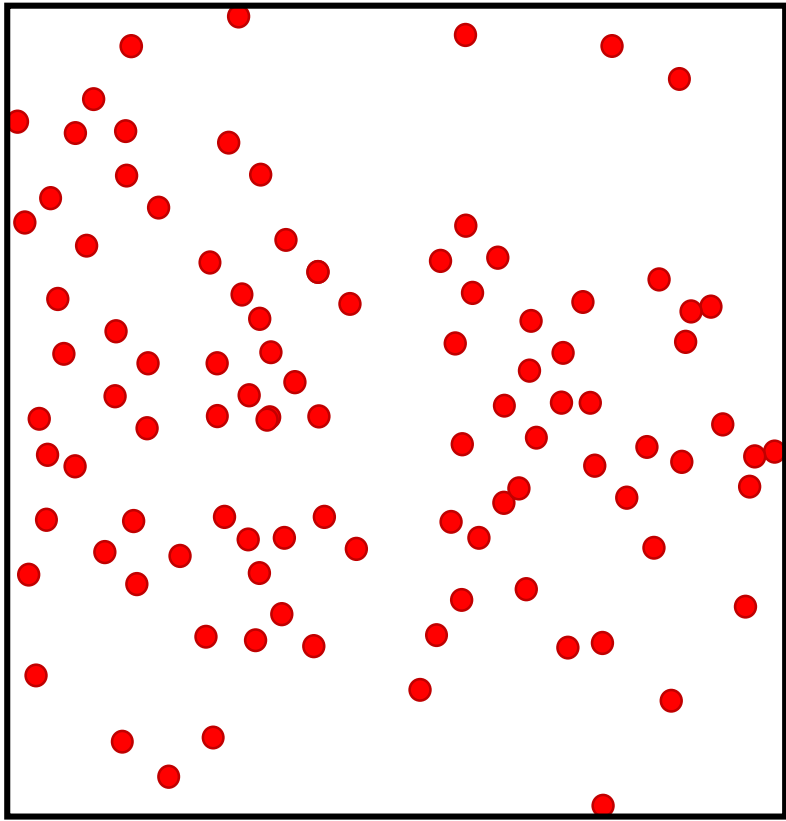
2D ruimte

Photonmapping – Photonmap building



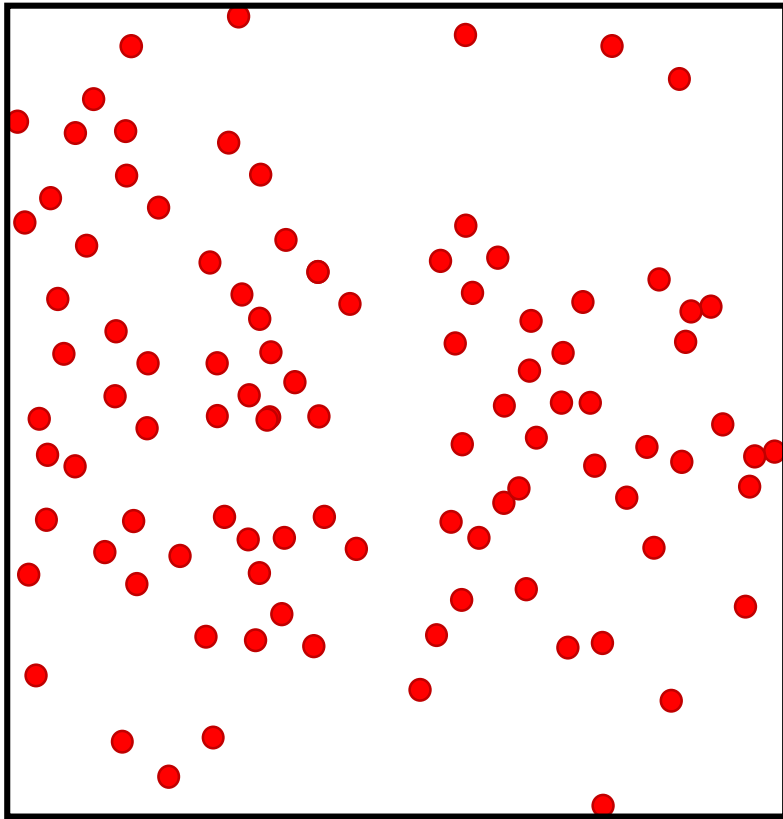
2D ruimte

Photonmapping – Photonmap building



2D ruimte

Photonmapping – Photonmap building



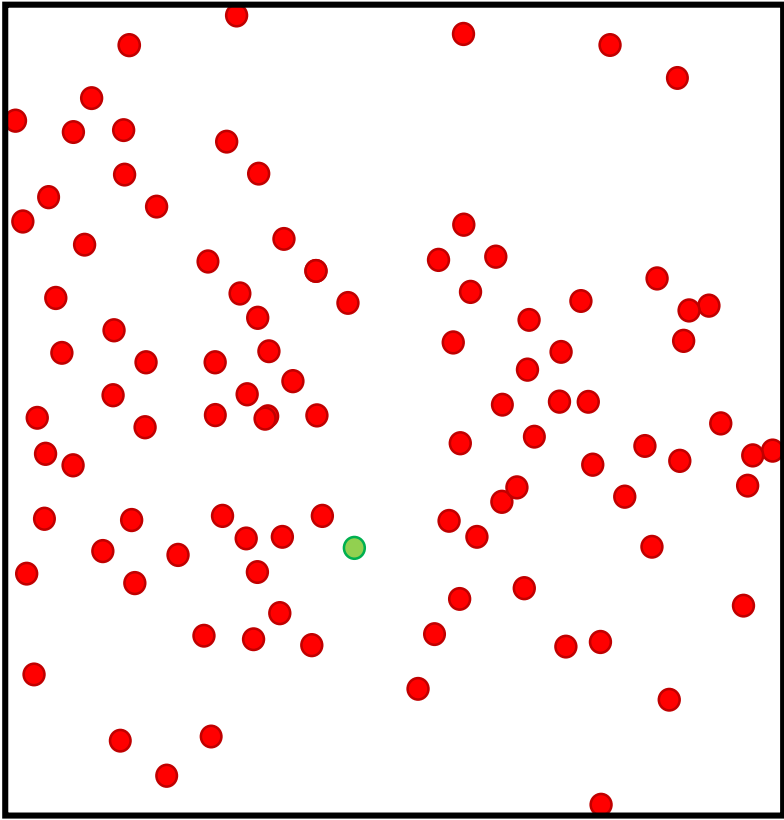
2D ruimte

Kd-boom photonmap

Opsplitsingsheuristiek

- Balanced Heuristic (BH)
- Voxel Volume Heuristic (VVH) [Wald et al. 2004]

Photonmapping – Photon tracing

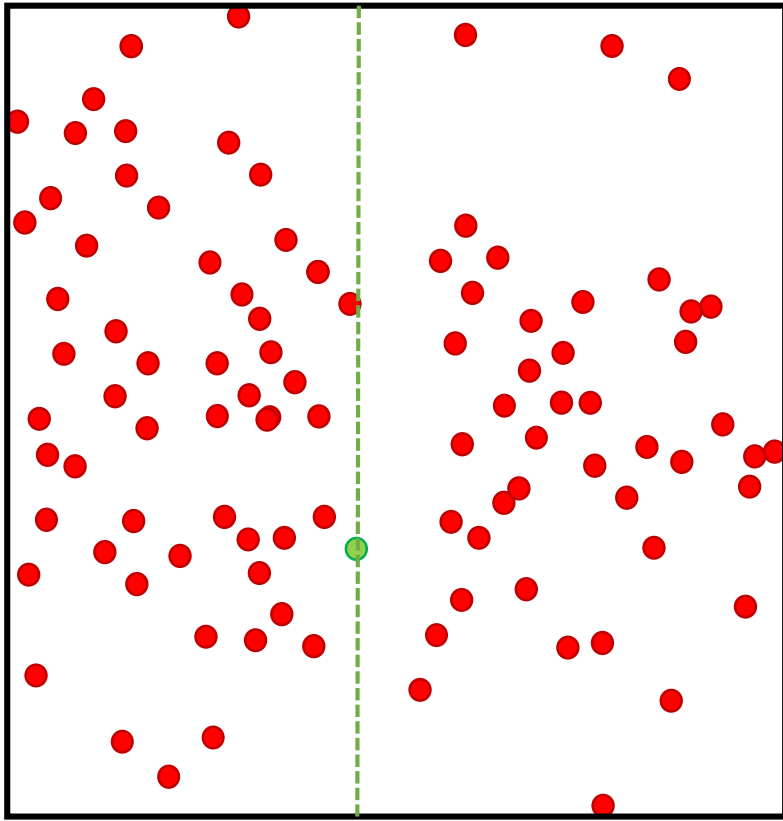


2D ruimte

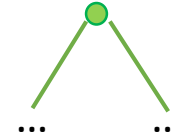


kd-boom datastructuur

Photonmapping – Photon tracing

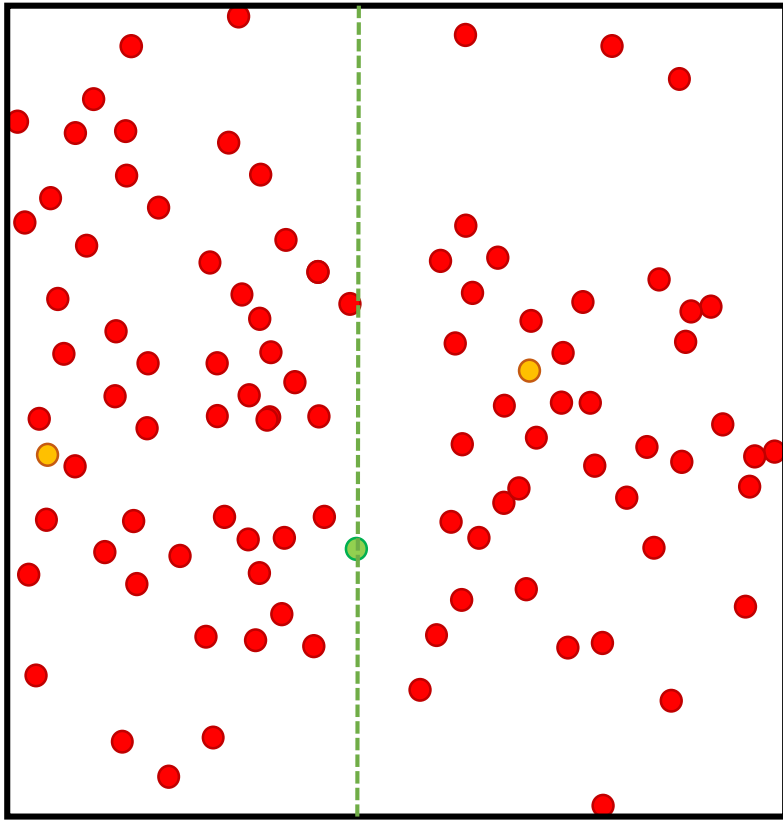


2D ruimte

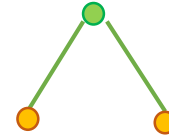


kd-boom datastructuur

Photonmapping – Photon tracing

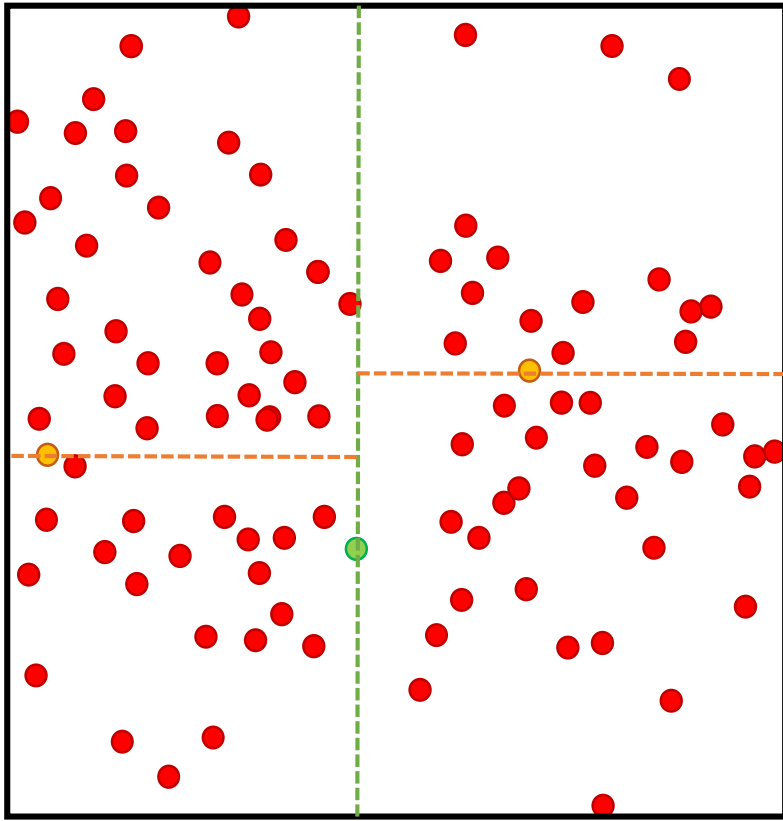


2D ruimte

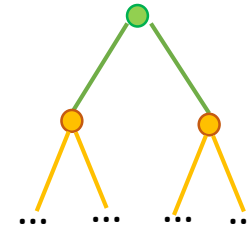


kd-boom datastructuur

Photonmapping – Photon tracing

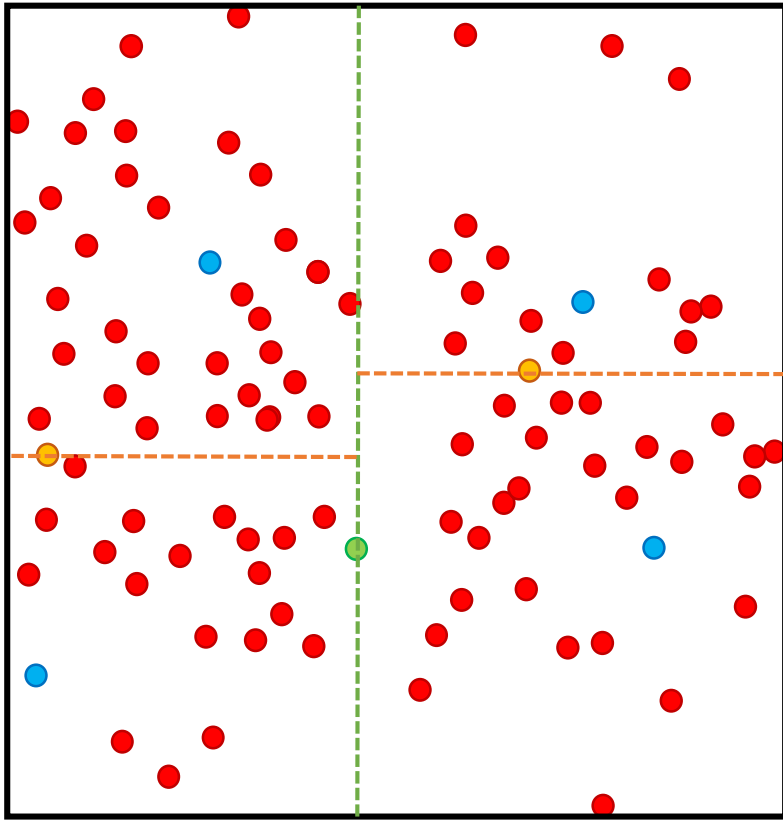


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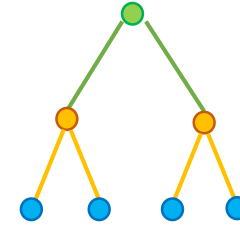


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Photonmapping – Photon tracing

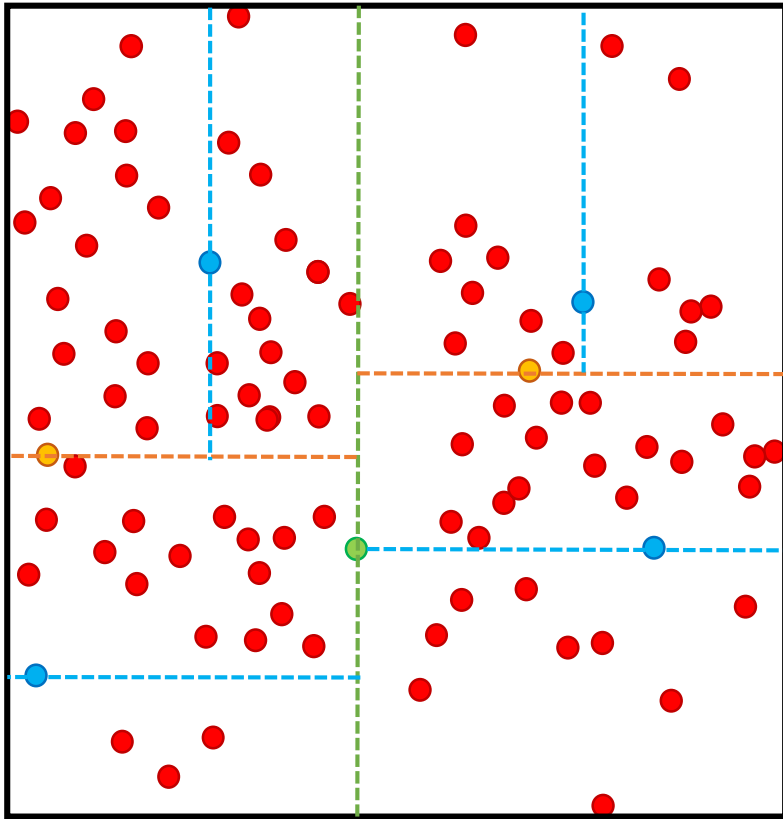


2D ruimte

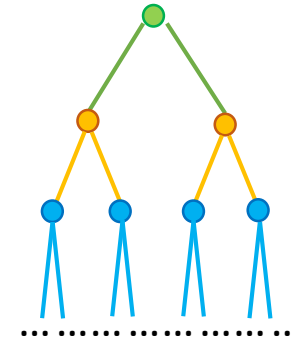


kd-boom datastructuur

Photonmapping – Photon tracing

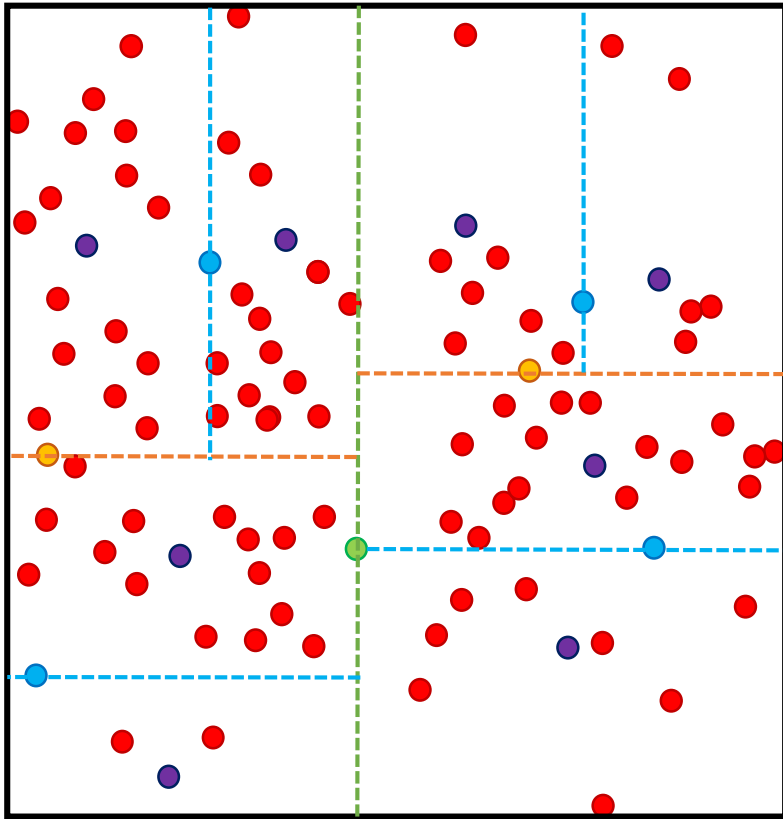


2D ruimte

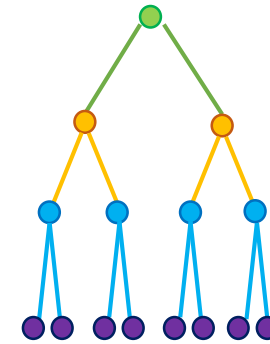


kd-boom datastructuur

Photonmapping – Photon tracing

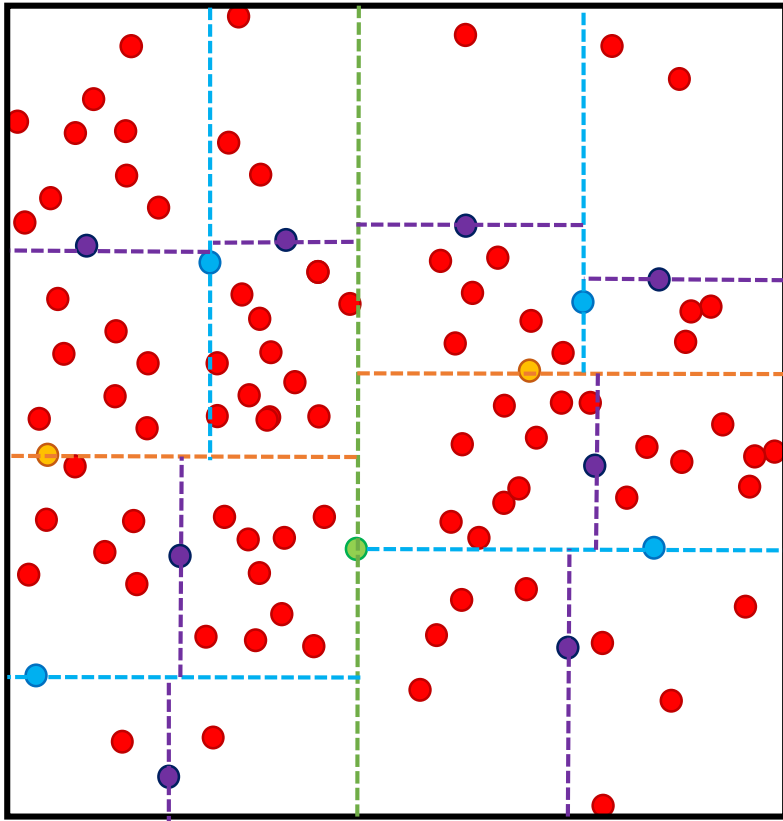


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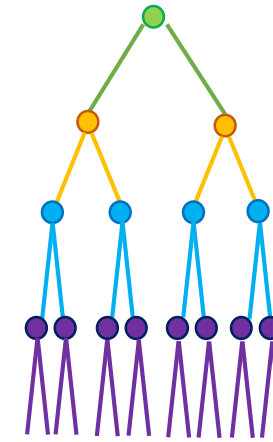


kd-boom datastructuur

Photonmapping – Photon tracing



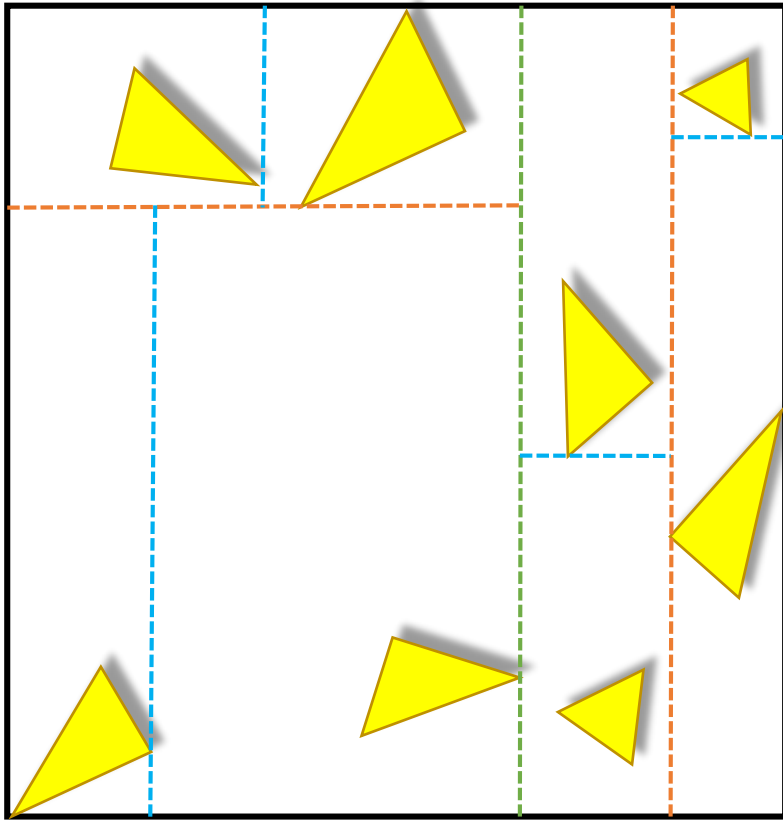
2D ruimte



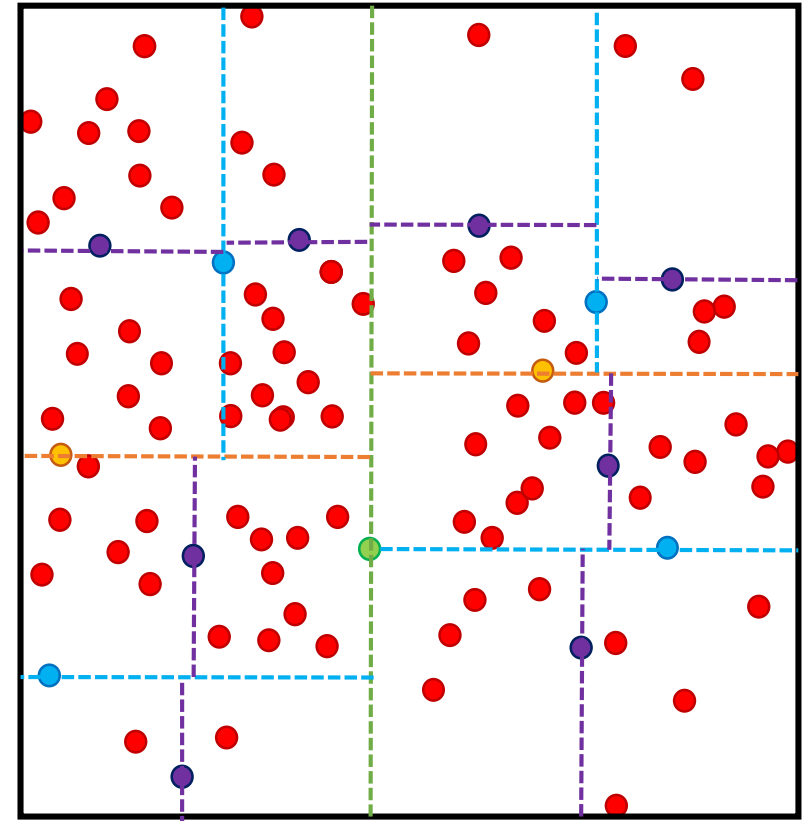
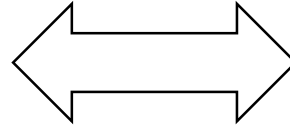
enzovoort

kd-boom datastructuur

Twee aparte kd-bomen

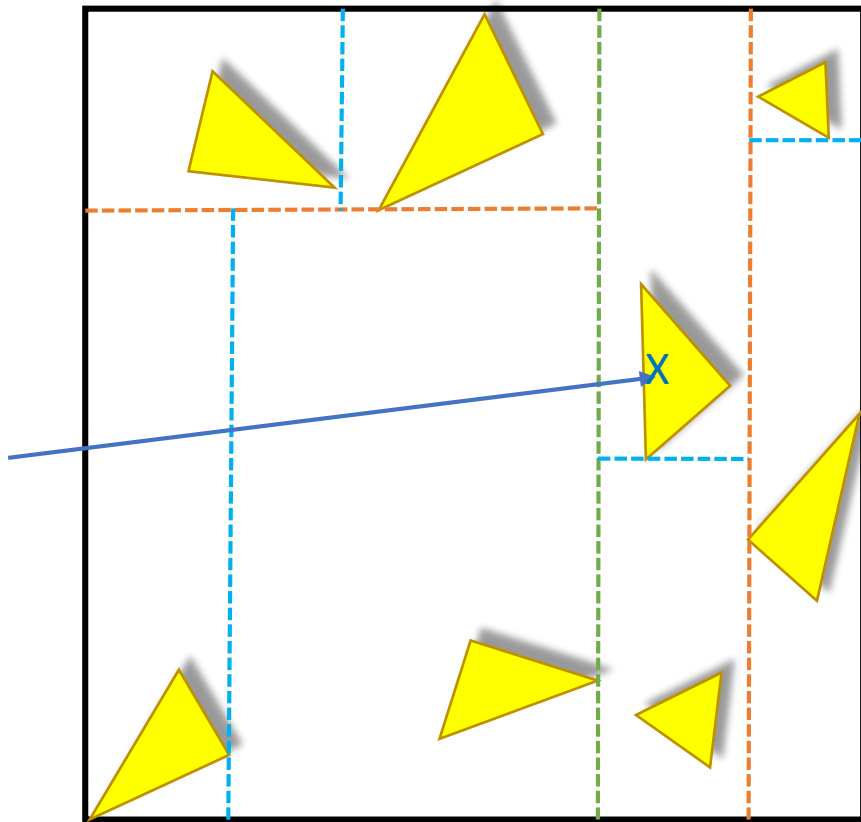


Geometrische primitieven

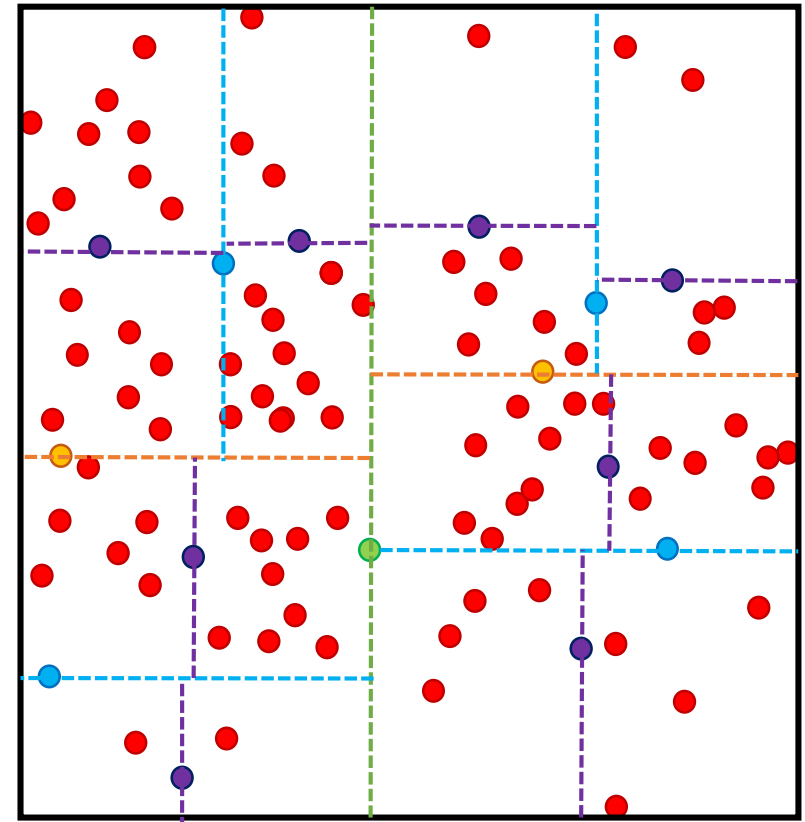
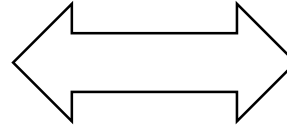


Photons

Twee aparte kd-bomen

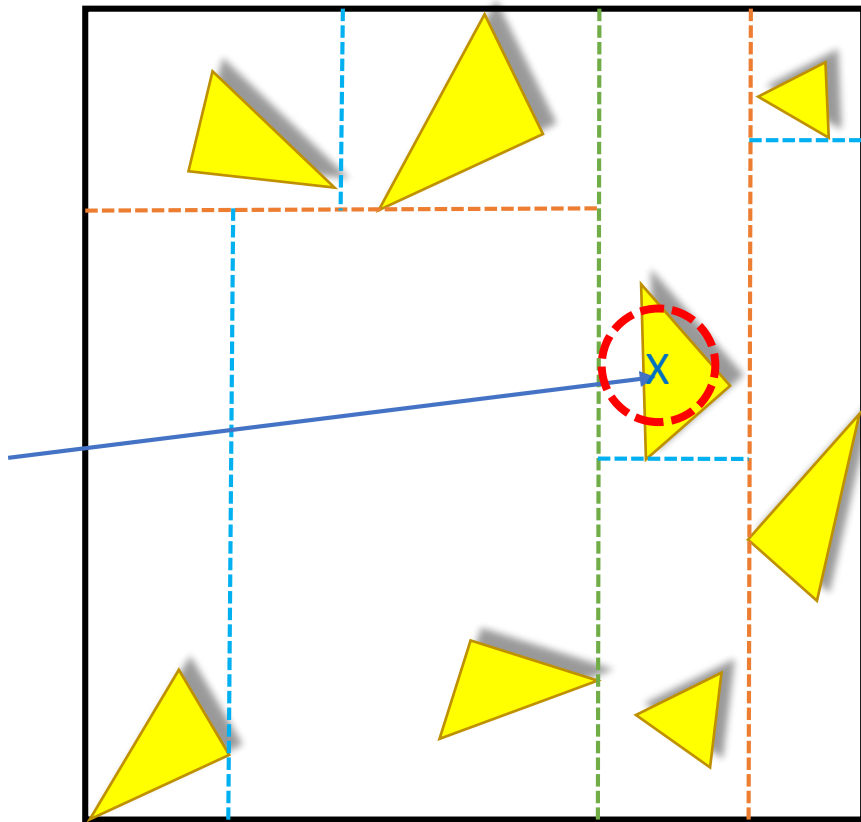


Geometrische primitieven

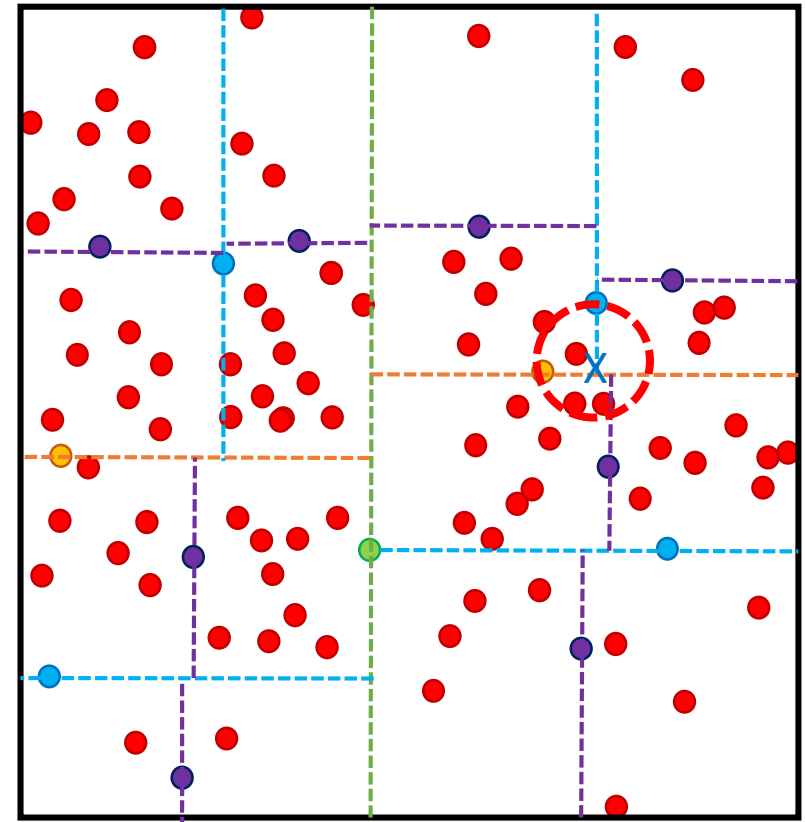


Photons

Twée aparte kd-bomen

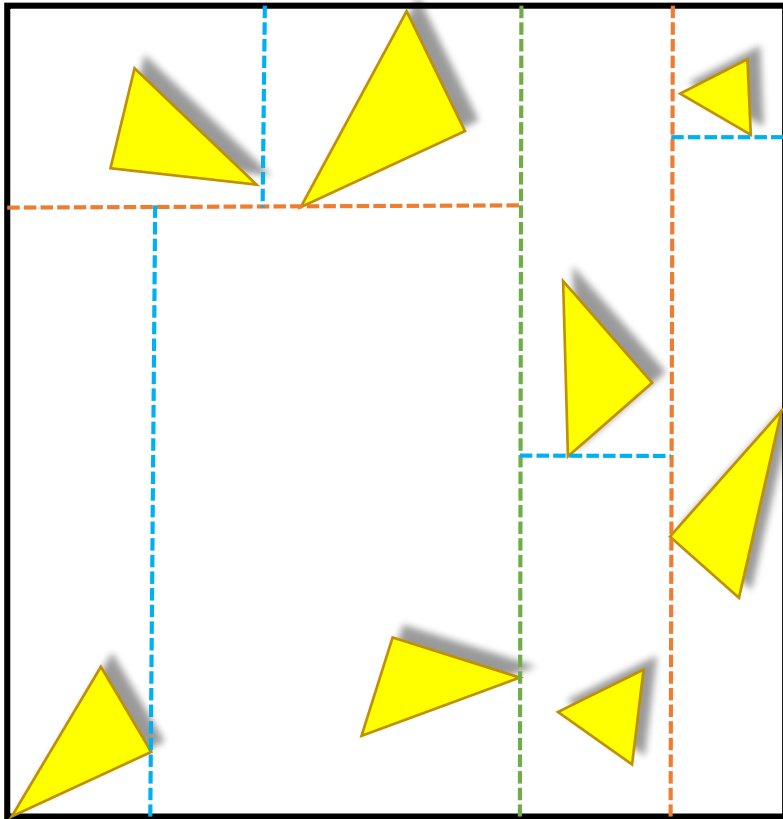


Geometrische primitieven



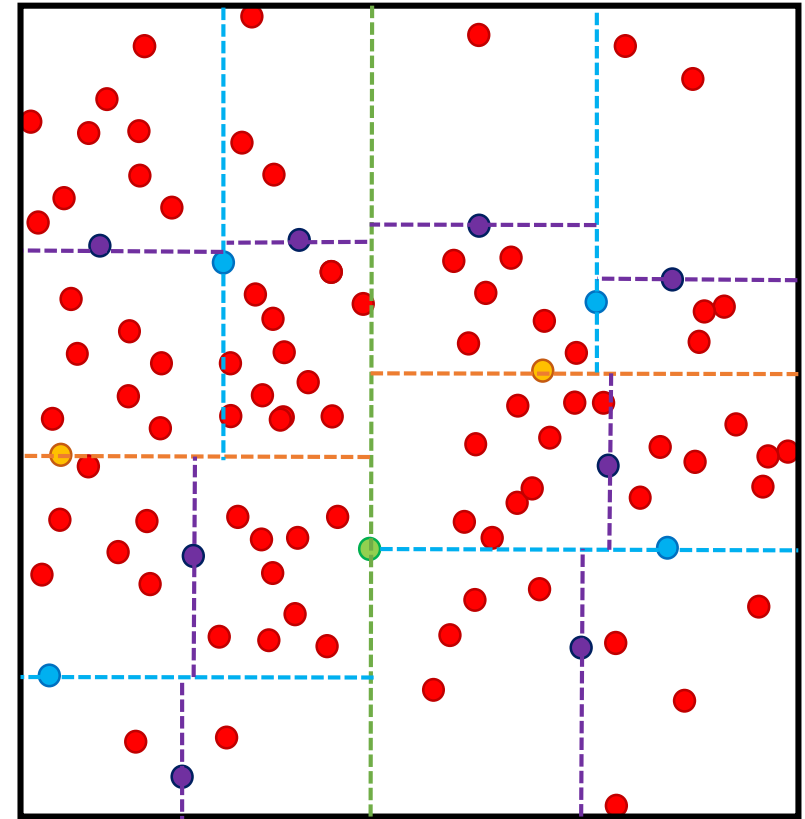
Photons

Eén kd-boom



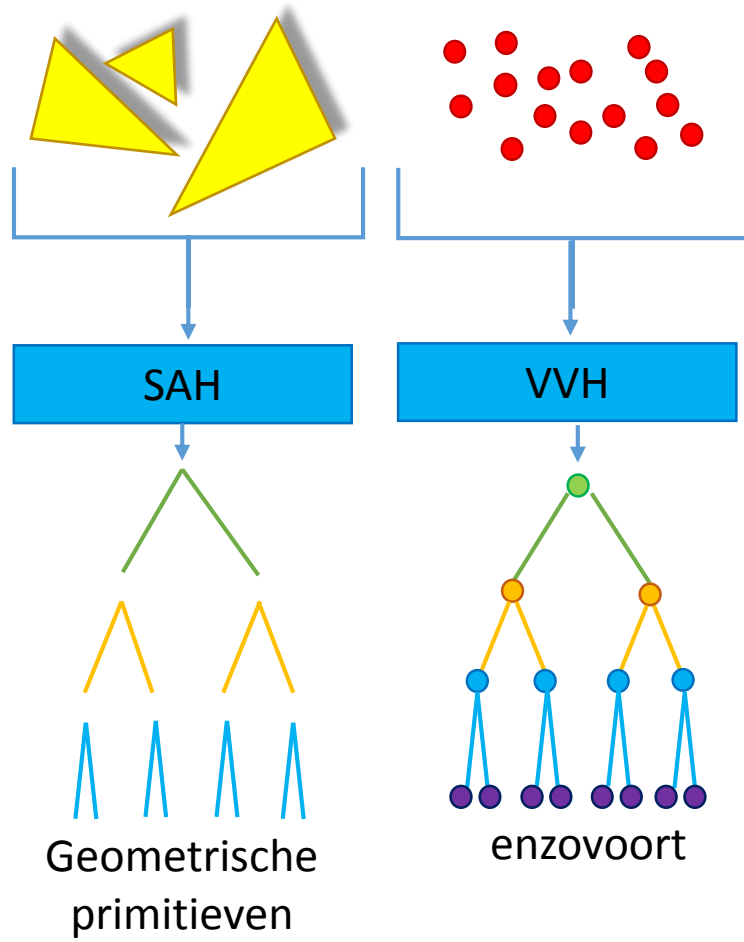
Geometrische primitieven

+



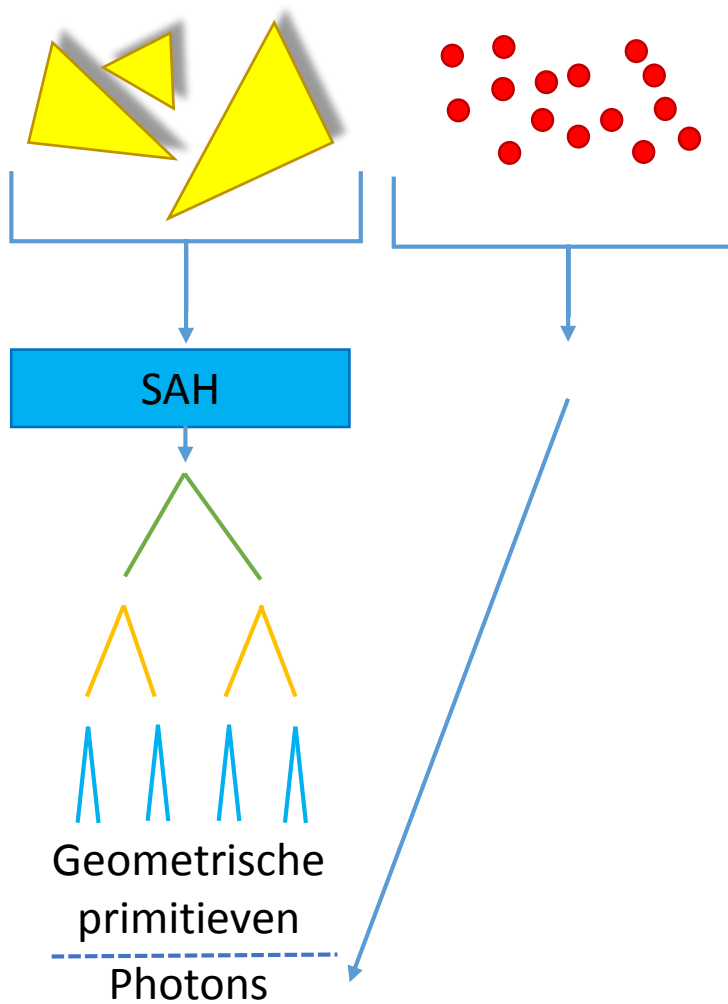
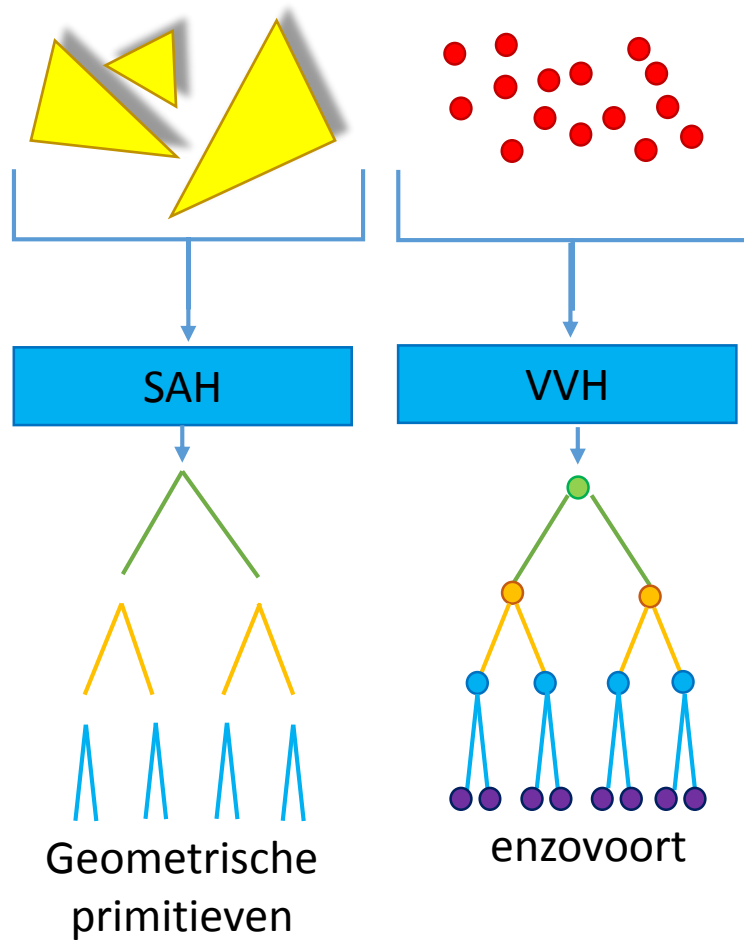
Photons

Photon Map



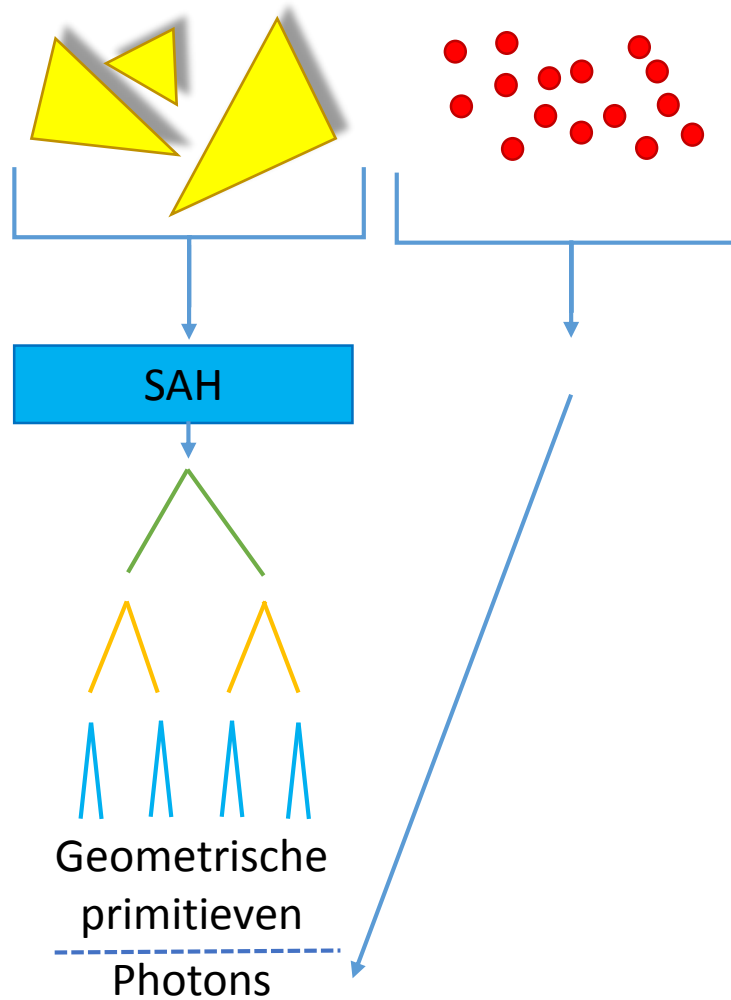
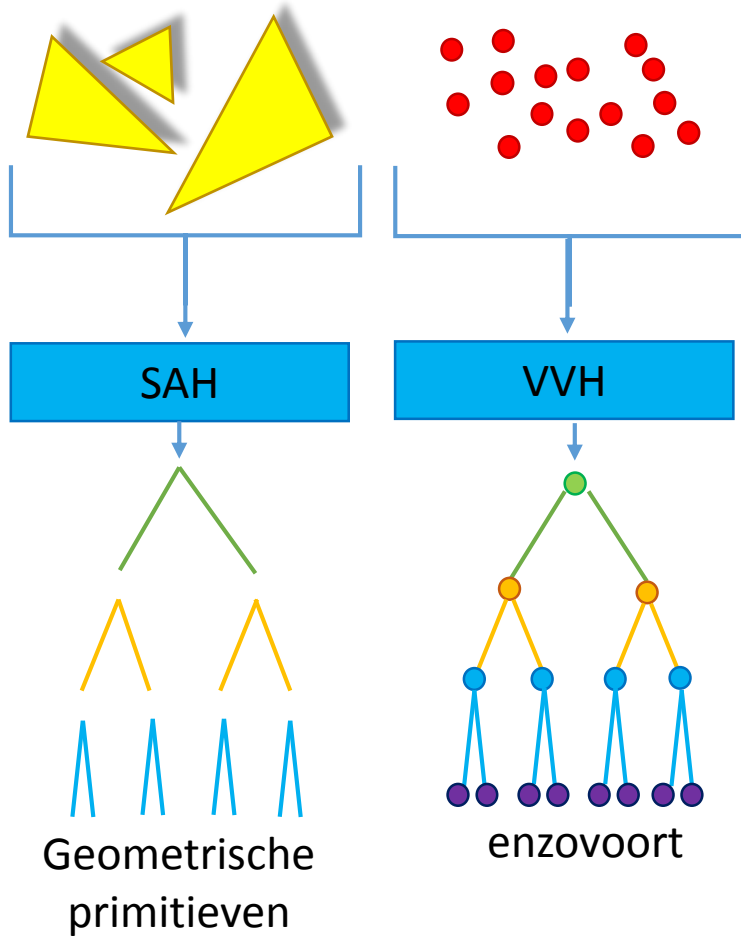
Photon Map

Hybrid Additive Photon Map



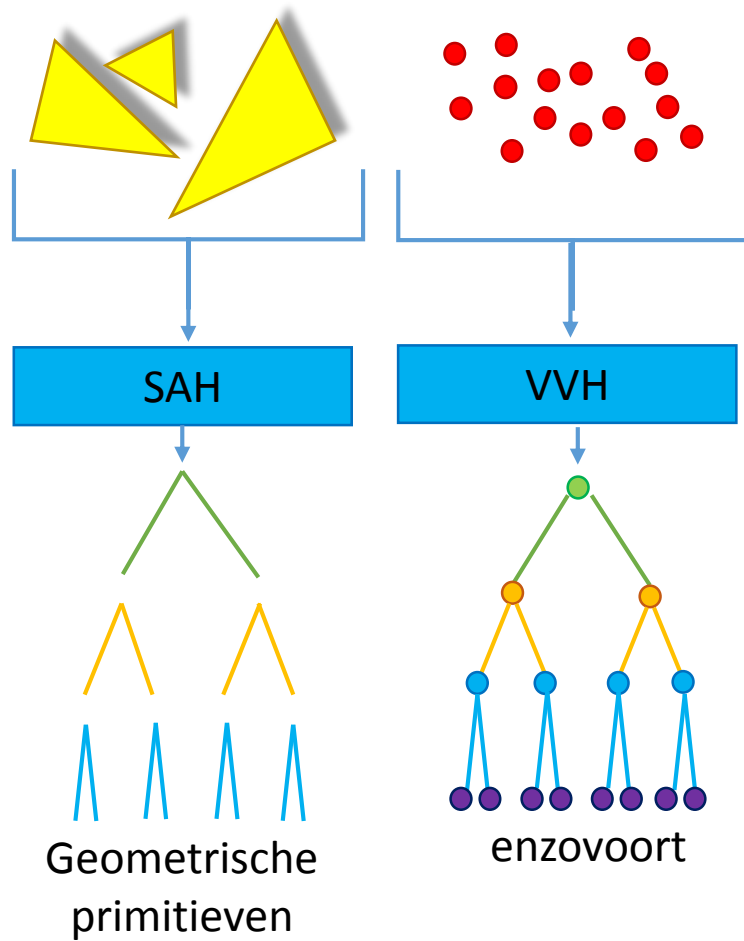
Photon Map

Hybrid Additive Photon Map

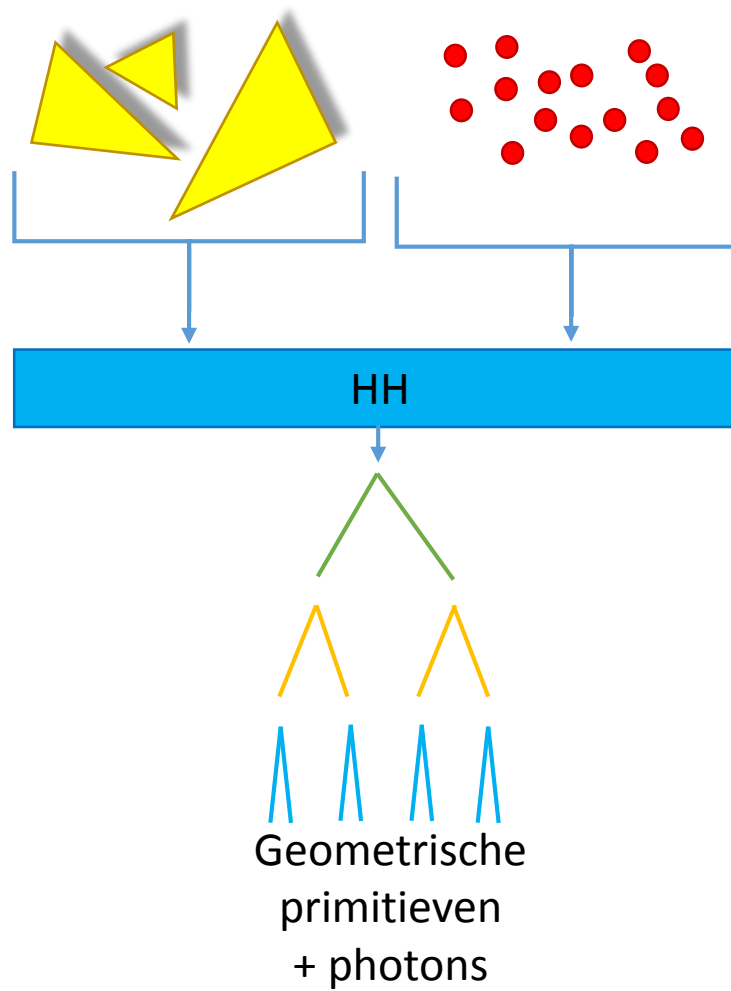


Geen onderscheid tussen ray tracing
en k-nearest neighbor query's

Photon Map



Hybrid Swapping Photon Map

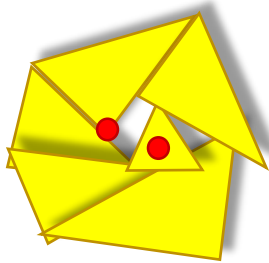


Hybrid Heuristic (HH)

1. Deel geometrische primitieven en photons op
2. Drop geometrische primitieven en photons

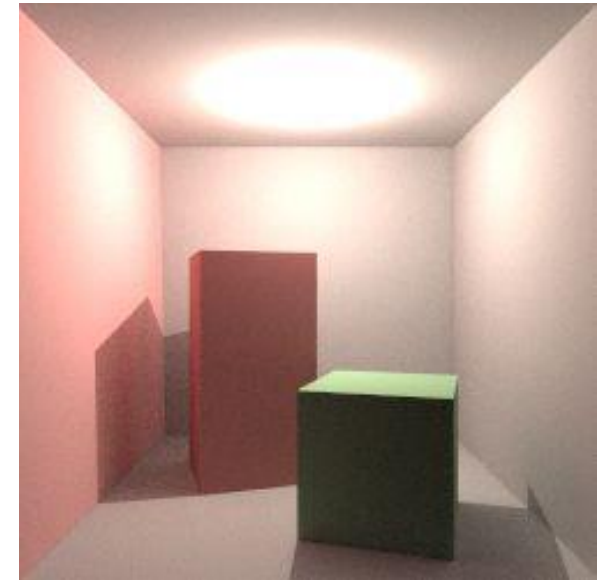
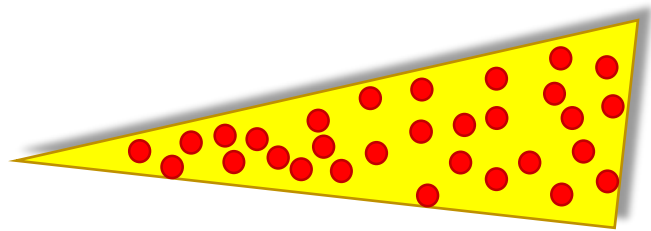
Hybrid Heuristic (HH)

1. Deel **geometrische primitieven** en **photons** op
2. Drop **geometrische primitieven** en **photons**
3. Deel **geometrische primitieven** op en drop **photons**



Hybrid Heuristic (HH)

1. Deel **geometrische primitieven** en **photons** op
2. Drop **geometrische primitieven** en **photons**
3. Deel **geometrische primitieven** op en drop **photons**
4. Drop **geometrische primitieven** en splits **photons** op



Hybrid Heuristic (HH)

1. Deel geometrische primitieven en photons op
 2. Drop geometrische primitieven en photons
 3. Deel geometrische primitieven op en drop photons
 4. Drop geometrische primitieven en splits photons op
- > Ray tracing en k-nearest neighbor query's gekoppeld via hitpunt

Hybrid Heuristic (HH)

1. Deel geometrische primitieven en photons op
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- > Ray tracing en k-nearest neighbor query's gekoppeld via hitpunt
- > Kosten moeten vergelijkbaar zijn

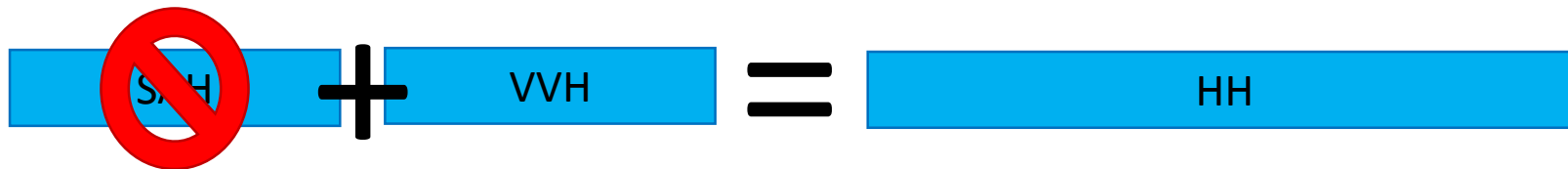
Hybrid Heuristic (HH)

1. Deel **geometrische primitieven** en **photons** op
 2. Drop **geometrische primitieven** en **photons**
 3. Deel **geometrische primitieven** op en drop **photons**
 4. Drop **geometrische primitieven** en splits **photons** op
- > Ray tracing en k-nearest neighbor query's gekoppeld via hitpunt
- > Kosten moeten vergelijkbaar zijn

$$\text{SAH} + \text{VVH} = \text{HH}$$

Hybrid Heuristic (HH)

1. Deel **geometrische primitieven** en **photons** op
 2. Drop **geometrische primitieven** en **photons**
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 4. Drop **geometrische primitieven** en splits **photons** op
- > Ray tracing en k-nearest neighbor query's gekoppeld via hitpunt
- > Kosten moeten vergelijkbaar zijn



Hybrid Heuristic (HH)

1. Deel **geometrische primitieven** en **photons** op
 2. Drop **geometrische primitieven** en **photons**
 3. Deel **geometrische primitieven** op en drop **photons**
 4. Drop **geometrische primitieven** en splits **photons** op
- > Ray tracing en k-nearest neighbor query's gekoppeld via hitpunt
- > Kosten moeten vergelijkbaar zijn

$$\text{RTSAH} + \text{VVH} = \text{HH}$$

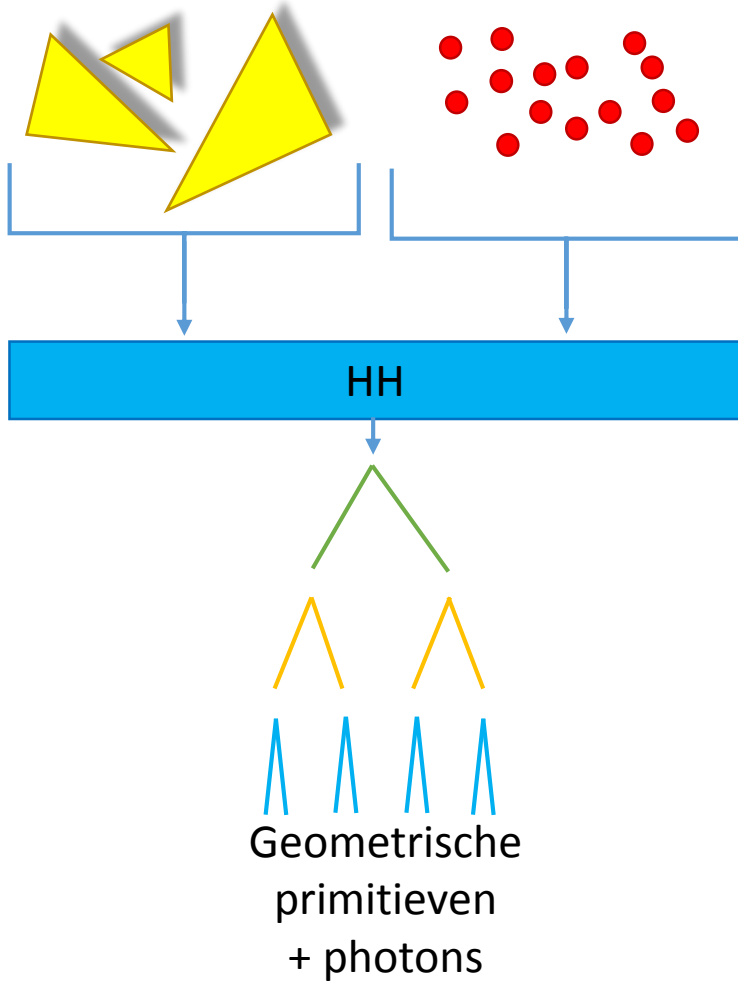


Efficient visibility heuristics for kd-trees using the RTSAH

Matthias Moulin, Niels Billen and Philip Dutré

Department of Computer Science
KU Leuven, Belgium

Hybrid Swapping Photon Map



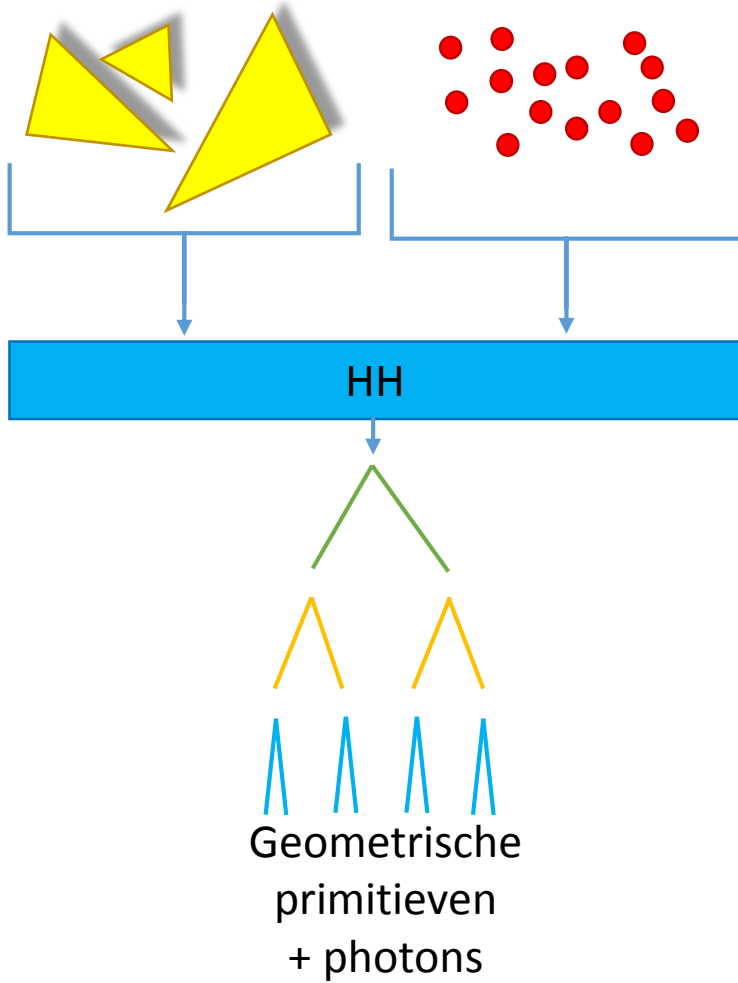
Speed up

- Vroege terminatie via omsluitende voxel
- Photons opdelen volgens geometrische primitieven

Helaas...

- Nieuwe acceleratiestructuur bouwen
- Lange bouwtijd
- Hoger geheugengebruik
- Puntdata versus niet-puntdata
- Ongekende informatie tijdens constructie
- Ray tracing versus k-nearest neighbor query's

Hybrid Swapping Photon Map



Speed up

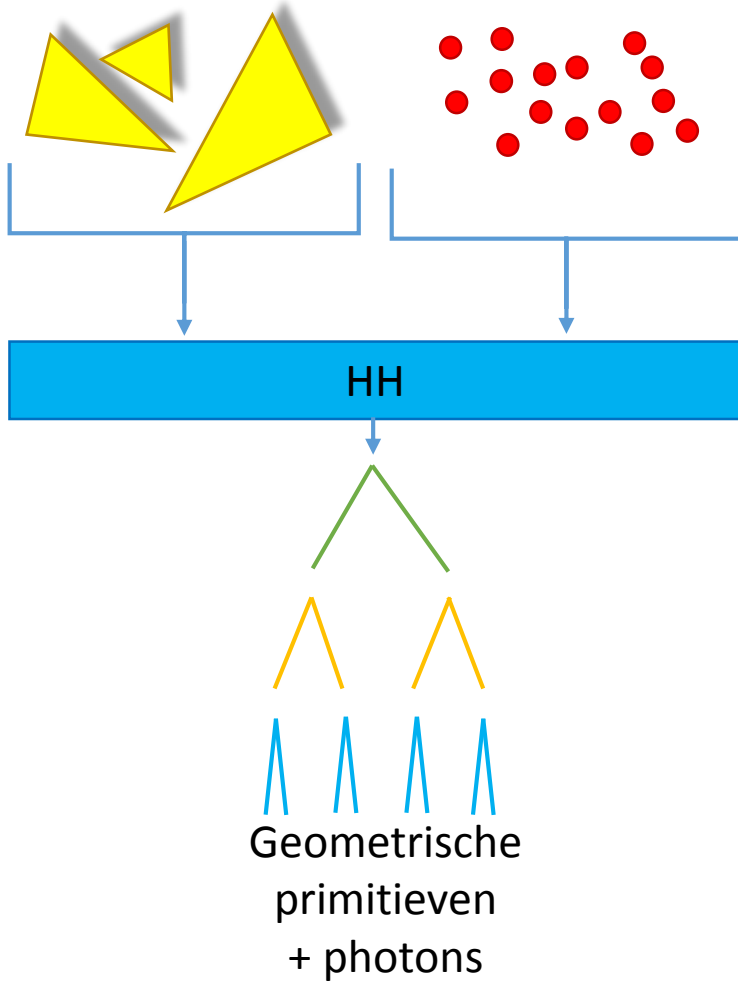
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Helaas...

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Hybrid Swapping Photon Map

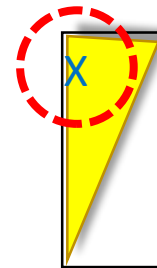


Speed up

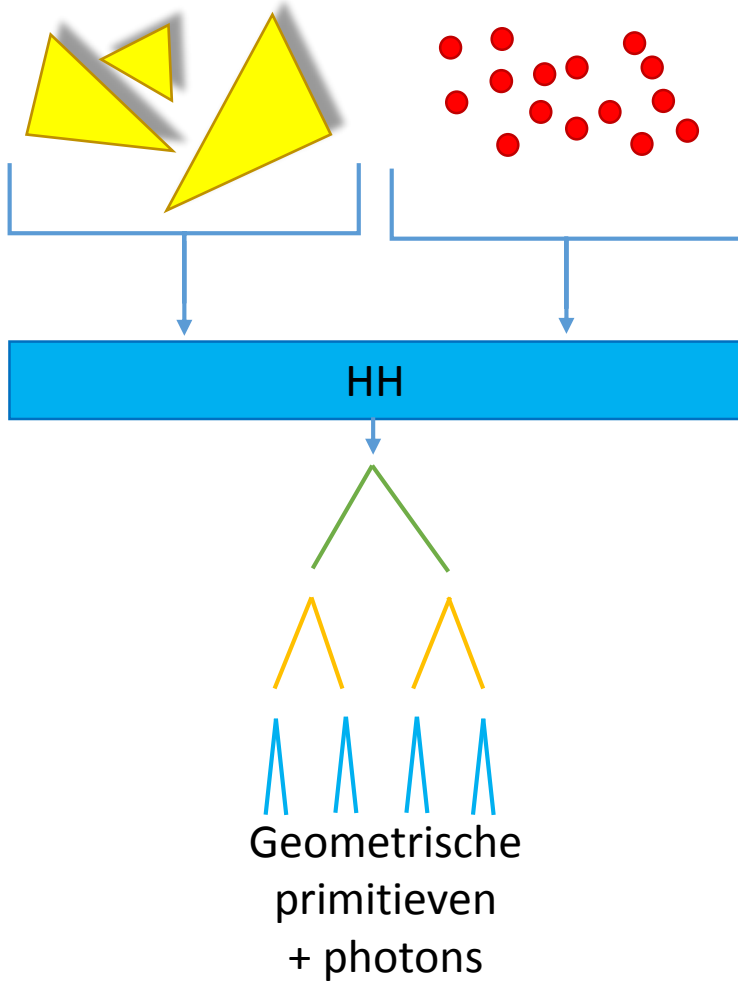
- Vroege terminatie via omsluitende voxel
- Photons opdelen volgens geometrische primitieven

Helaas...

- Nieuwe acceleratiestructuur bouwen
- Lange bouwtijd
- Hoger geheugengebruik
- Puntdata versus niet-puntdata
- Ongekende informatie tijdens constructie
- Ray tracing versus k-nearest neighbor query's



Hybrid Swapping Photon Map

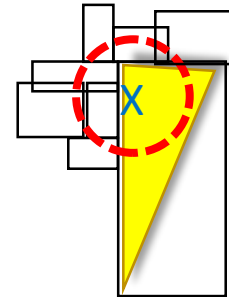


Speed up

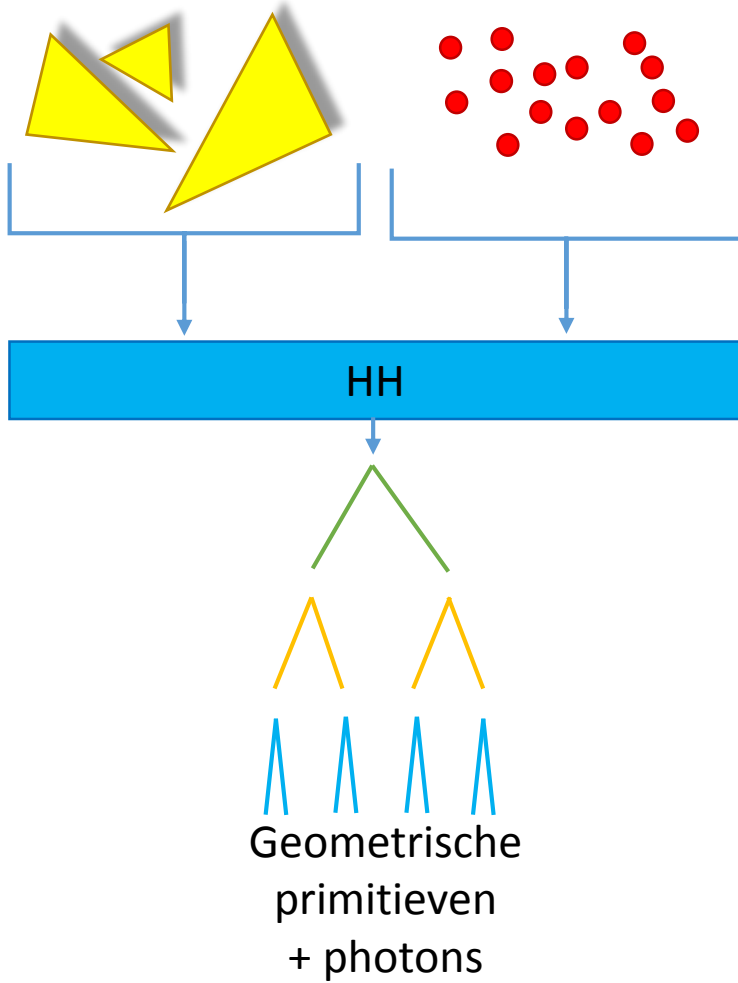
- Vroege terminatie via omsluitende voxel
- Photons opdelen volgens geometrische primitieven

Helaas...

- Nieuwe acceleratiestructuur bouwen
- Lange bouwtijd
- Hoger geheugengebruik
- Puntdata versus niet-puntdata
- Ongekende informatie tijdens constructie
- Ray tracing versus k-nearest neighbor query's



Hybrid Swapping Photon Map



Speed up

- Vroege terminatie via omsluitende voxel
- Photons opdelen volgens geometrische primitieven

Helaas...

- Nieuwe acceleratiestructuur bouwen
- Lange bouwtijd
- Hoger geheugengebruik
- Puntdata versus niet-puntdata
- Ongekende informatie tijdens constructie
- Ray tracing versus k-nearest neighbor query's
- Correctie voor gulzige bouwheuristiek

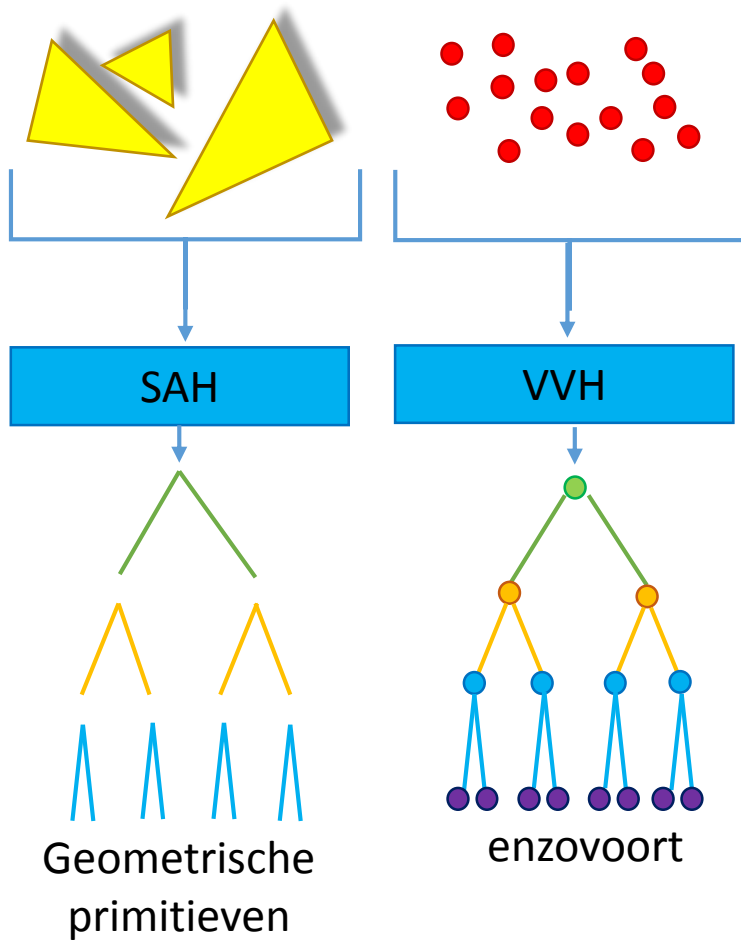
“The **decoupling** of the photon map(s) **from the geometry** is a significant advantage that not only simplifies the representation but also makes it possible to use the structure to represent lighting in very complex models.”

Henrik Wann Jensen, Realistic image synthesis using photonmaps

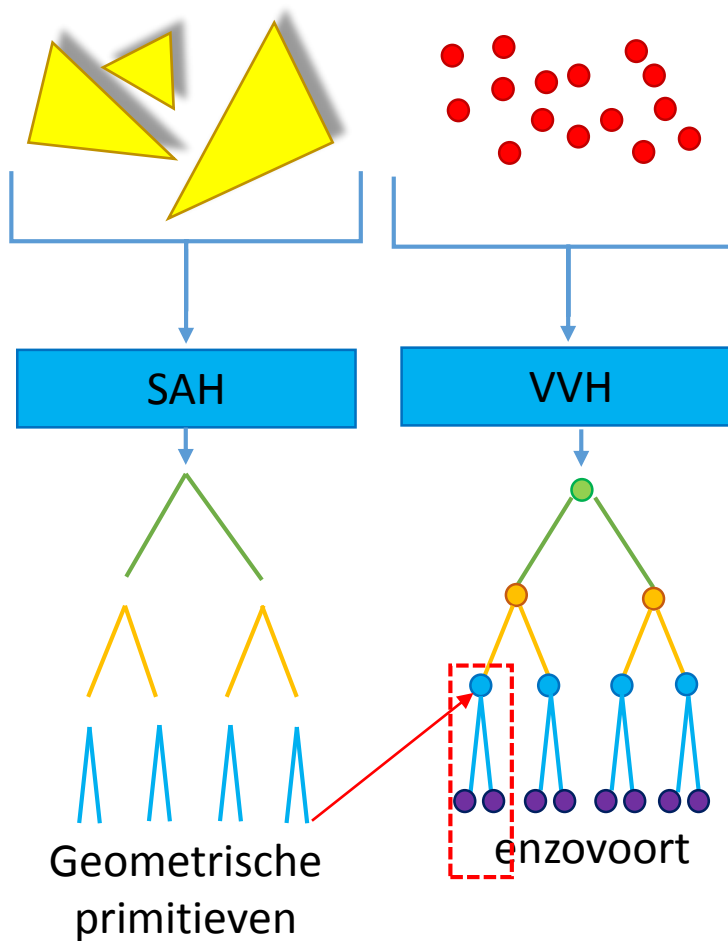
“Two separate kd-trees will always be faster”

Vlastimil Havran, EGSR15

Photon Map



Hybrid Connected Photon Map



Zelfreflectie

Pluspunten

- Regelmatig
- Zelfstandig
- Planmatig
- Autodidactisch
- Automatisatie

Minpunten

- Balans thesisonderwerp <> paperonderwerp
- Debugging fase
- Volledig design -> implementatie (Luca Fascione)
- Paper georiënteerd



The End

