
Physically-based Cloud Rendering on GPU

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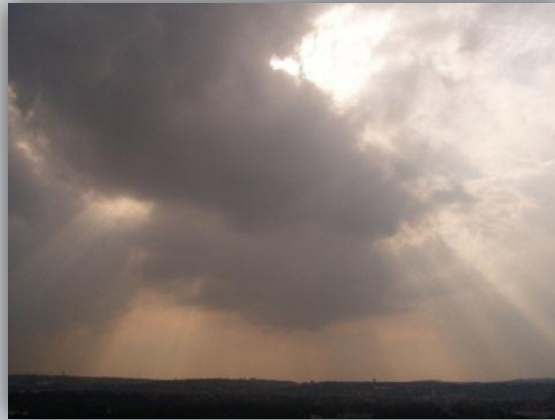
Opponent: Ing. Jaroslav Křivánek, Ph.D.



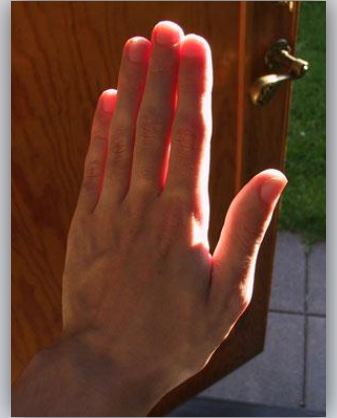
- Participating media rendering



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- Clouds
 - shape and size
 - high reflectivity
 - anisotropy



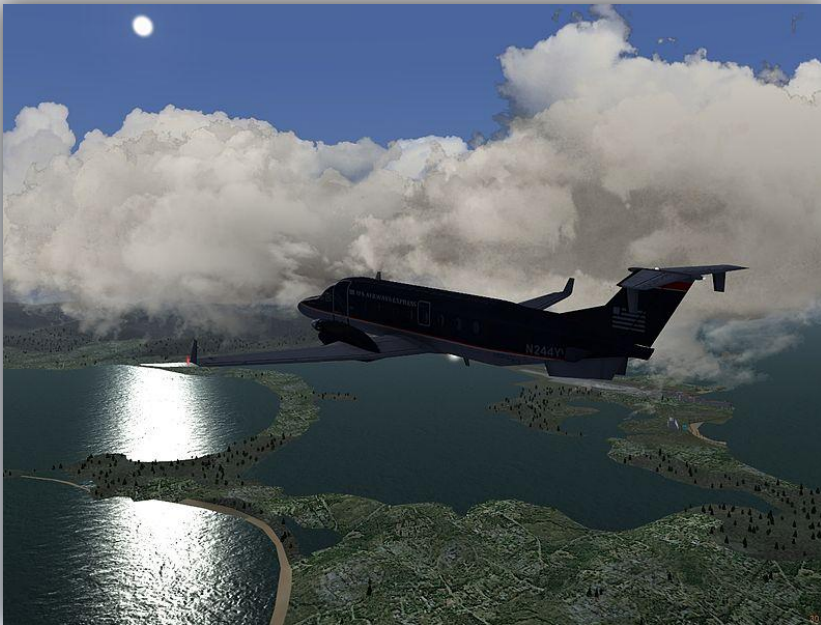
- Participating media rendering
- Clouds
- Energy transport equation

$$\frac{dL(x, \vec{\omega})}{dx} = -\sigma_t L(x, \vec{\omega}) + \sigma_a L_e(x, \vec{\omega}) + \sigma_s \int_{4\pi} L(x, \vec{\omega}') p(x, \vec{\omega}', \vec{\omega}) d\vec{\omega}'$$

- Interactive applications

Motivation

- Interactive applications
- Flight simulations



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- Computer games



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- Interactive applications
- Flight simulations
- Computer games
- Scientific visualizations



- Interactive applications
- Flight simulations
- Computer games
- Scientific visualizations
- General participating media

- Existing methods



Wang [2004]



Kalos et al. [2005]



Wenzel [2006]



Bouthors et al. [2008]

- Existing methods
- Proposed method:
 - Physically-plausible
 - Conceptually intuitive
 - Built on realistic assumptions



- Photon mapping

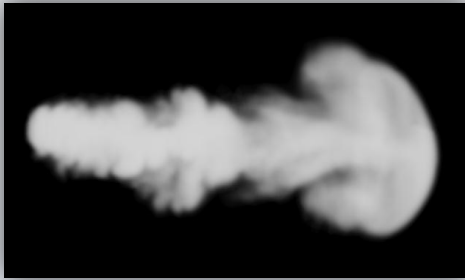
Solution

- Photon mapping
- Spherical harmonics

Solution

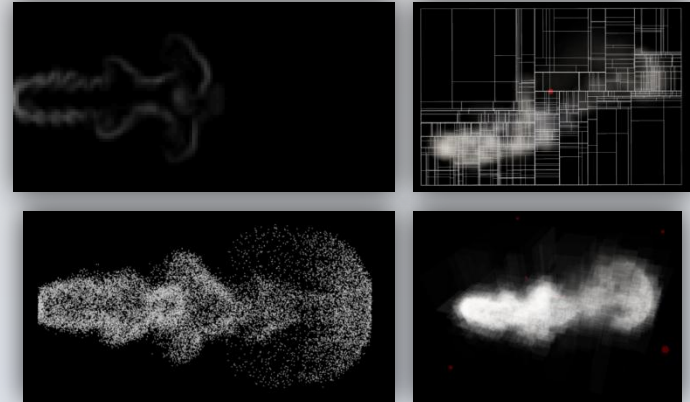
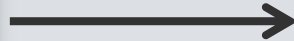
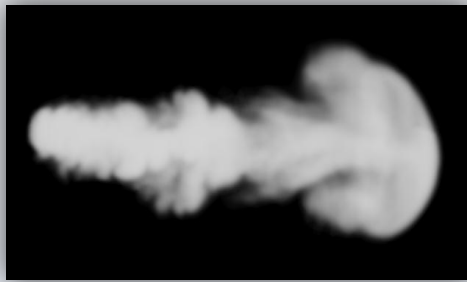
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- Heavy GPU utilization

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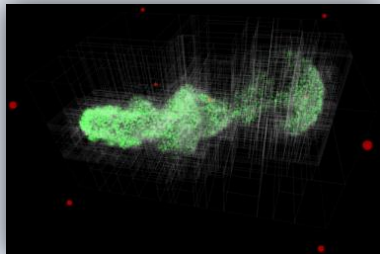
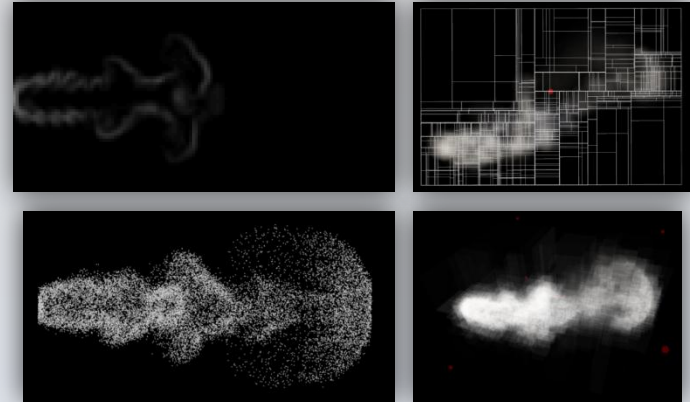
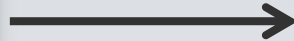
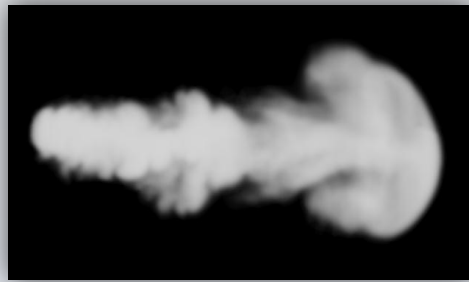
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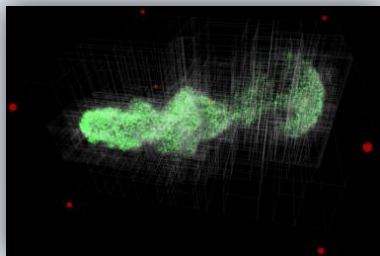
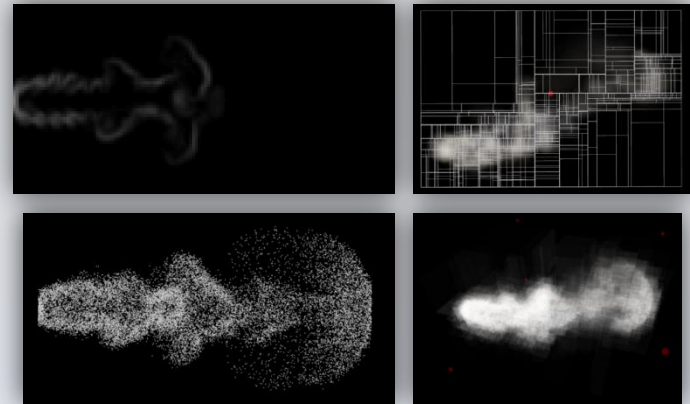
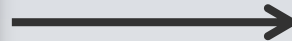
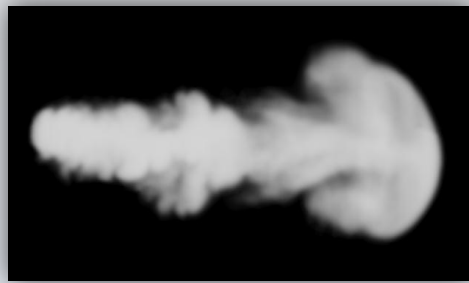
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- Data pre-processing: **~1s**
- Rendering: **~5 FPS / ~20 FPS**

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- Rendering: **~5 FPS / ~20 FPS**
- Qualitatively correct results



- Pros
 - Interactive yet physically-based method
 - Temporal coherency
 - Extensibility
 - Novelty

- Pros
 - Interactive yet physically-based method
 - Temporal coherency
 - Extensibility
 - Novelty
- Cons
 - Prototype – further development required

End



Computer
Graphics
Charles
University

- Reference images



- Reference images
- Multiple clouds

