A short presentation on my background in computer graphics

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Outline

About Me...

- My name is **Morteza Mostajab** [BAM14] [CW14]
- Bachelor studies:
  Hamedan University of Technology, Iran
- Maseter studies:
  Technische Universität München
- Present:
  Researcher at Fraunhofer IGD, Darmstadt
- Research interests:
  Real-time physically-based rendering
  (Rasterization-based or Ray-tracing)
  Virtual reality
  Computer graphics and visualization
  Game Programming

Inspiration

- Games, Animations, Movies with Special Effects,...

(a) Last Ninja 3

(b) Gears of War

(c) Ratatouille

(d) The lord of the rings

- My firsts...

(e) First Computer

(f) First IBM compatiable PC

(g) First Console (Atari 2600)

Outline

Motivation

- **Goal**: Use virtual reality to help engineers getting a better **understanding** of simulations, make **investigation** in flow field features easier.
- Virtual reality applications demands 75-140 frames per second scene update and rendering to reduce **latency**.
- **Initial motivation**:
  – **Immersive Streamline Demo**: a demo which user could stand in a simulation model to understand flow field features by:
  - Prototype demo which placed the user virtually in simulation model.
  - User could interact with virtual world by moving streamlines' seeding plane.
  - User could walk around in the simulation model, look closer into streamlines to understand flow field's features better.

Immersive Streamline Demo

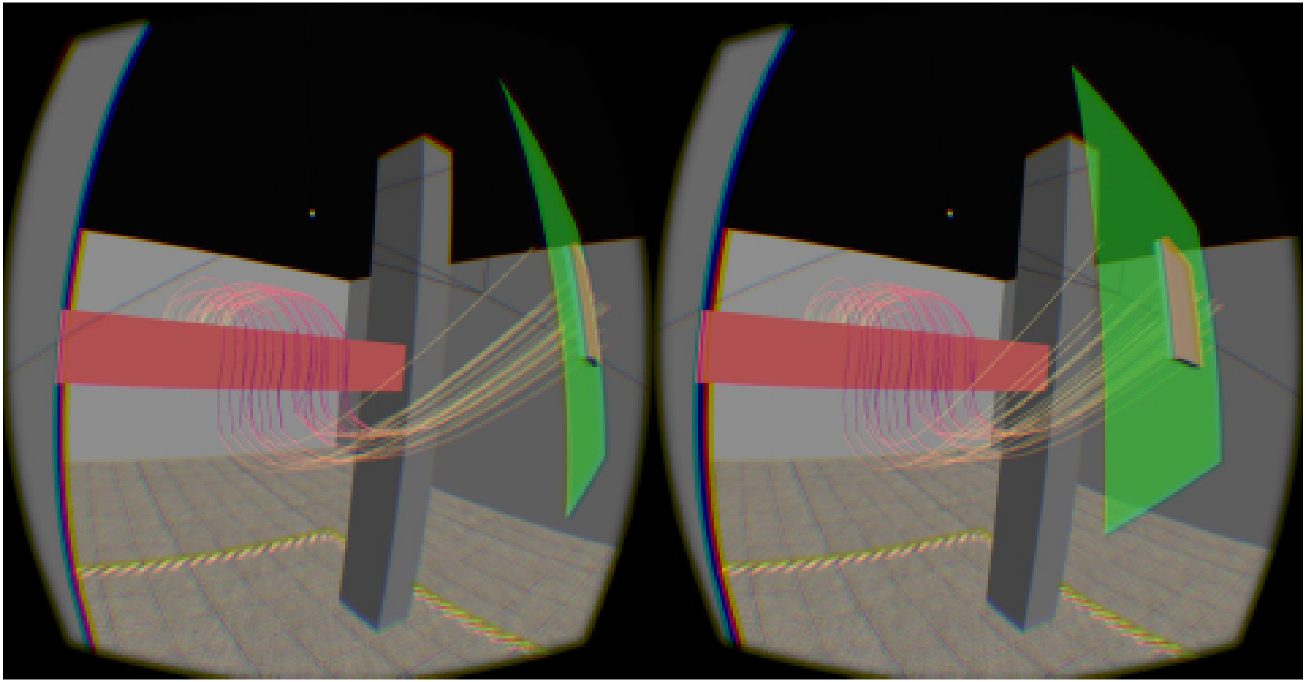

Figure 1: **Immersive Streamlines** was a prototype demo done at Fraunhofer IGD. The user is able to move inside the virtual world, interact with it, and look closely at the flow visualization results. The image shows a stereo pair, which is displayed on Oculus Rift HMD.

Problem Definition

- Streamline's computation was 10 frames per second (latency was very visible to user).
- Streamline's accuracy was not high enough (straight lines in streamlines are visible in the screenshot).
- Stream surfaces can provide more information about flow fields features.

Main Contributions

- Investigation techniques from ray tracing field for application in streamline computation:
  – Using acceleration structures
  – Using ray-packing
- Using heterogeneous computing:
  – Scale streamline computation on all capable devices.
  – Scale rendering on all graphic processing units.

Related Works

- Parallel stream surface computation for large data sets [CCG$^+$12]. proposed a distributed stream surface computation system.
  – **My method is not distributed but uses all available computation devices.**
- Interactive Streak Surface Visualization on the GPU [BFTW09]. Bue+09 samples the simulation mesh on a regular grid, then compute the streak surface.
  – **Reduces accuracy, ignores a lot of information exist in simulation mesh by sampling it on a regular grid.**

Related Works

- Interactive particle tracing for the exploration of flow fields in virtual environments [Sch08].
  Sch08 uses the neighboring graph instead of acceleration structure on GPU.
  – **step size needed to be small enough.**
- Fast, Memory-Efficient Cell Location in Unstructured Grids for Visualization [GJ10].
  introduces cell-tree acceleration structure use it for particle tracing.
  – **I have evaluated more acceleration structures to classify them based on memory requirements and performance.**

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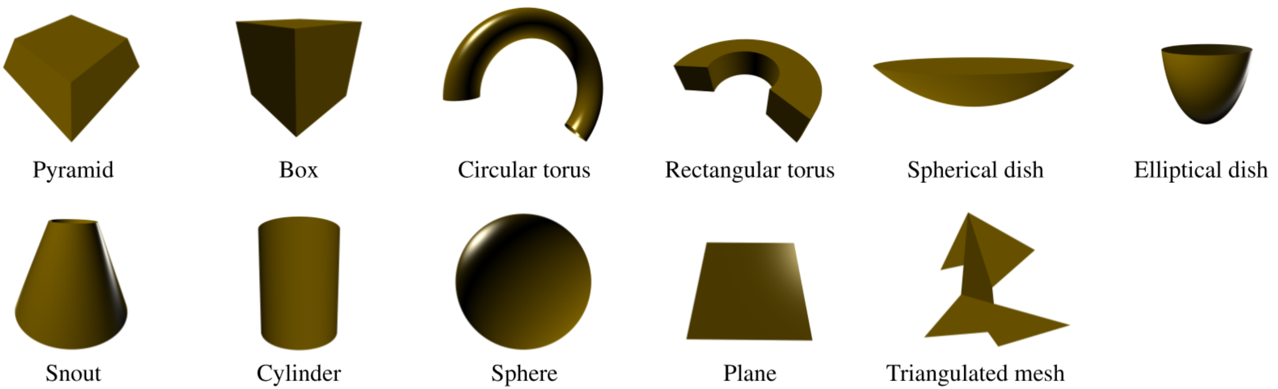
1. Introduction
2. Master Thesis
3. Ray tracing revisited for rendering CSG models consisting of higher order primitives
4. Voxel based path tracing

Supported Higher order primitives



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- Matthäus G. Chajdas and Rüdiger Westermann, *Quantitative Analysis of Voxel Raytracing Acceleration Structures*, Pacific Graphics Short Papers (John Keyser, Young J. Kim, and Peter Wonka, eds.), The Eurographics Association, 2014.

References II

- C. Garth and K.I. Joy, *Fast, memory-efficient cell location in unstructured grids for visualization*, Visualization and Computer Graphics, IEEE Transactions on **16** (2010), no. 6, 1541–1550.
- Marc Schirski, *Interactive particle tracing for the exploration of flow fields in virtual environments*, 2008, pp. X, 139 S. : Ill., graph. Darst.

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