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Dense 3D culture rendering using NVIDIA solutions in Immersive Training Systems

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Overview

- Immersive Training
- NVIDIA GPU Performance History
- Dense Content: Then and Now
- Realism: All altitudes and times of day
- Rendering Frame Budgeting

Immersive Visual Systems

Training Systems & Government Services | **Visual Systems IPT**

- **Large number of video channels surrounding eyepoint**

Immersive Training

- **Goal: A totally immersed trainee**
- **Levels: Engagement, engrossment, total immersion [1]**
- **Studies: Higher fidelity: improved tactical training [3]**
- **Studies: Experienced pilots require more immersion for effective training [2]**
- **“How real should it be?”**

Wide area datasets

- **Global coverage**
- **Inset design: landable, Low altitude**
- **Large training areas**
- **All weather conditions**
- **All times of day**

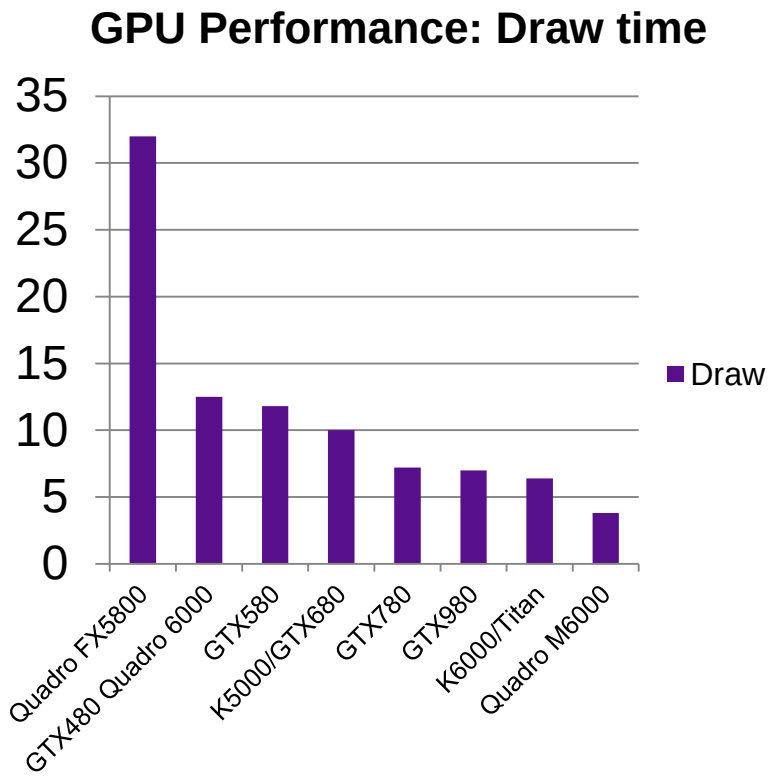
Immersion: Scene Quality

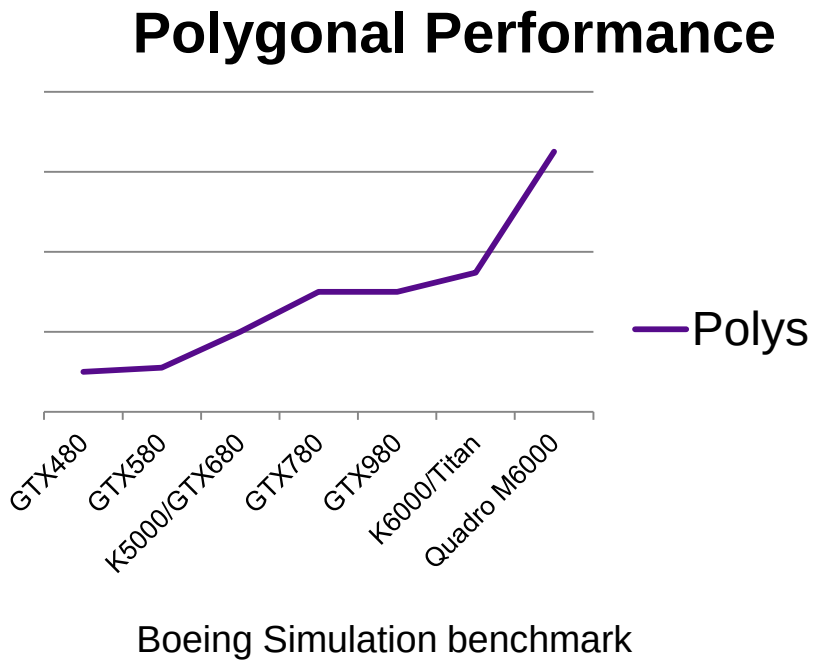
- **Display system resolution, dynamic response, and brightness**
- **Terrain satellite Imagery resolution**
- **Topography accuracy (quality)**
- **Image Generator rendering capabilities at all ranges:**
  - ✓ Terrain Skin Tessellation
  - ✓ 3D Culture
  - ✓ Moving Models
- **Limited artifacts**
- **High performance**

Immersion, Scene Composition

- GPU performance allows higher quality buildup
- Terrain skin
- 3D buildings
- Dense trees
- Street rendering
- Shadows
- Winds

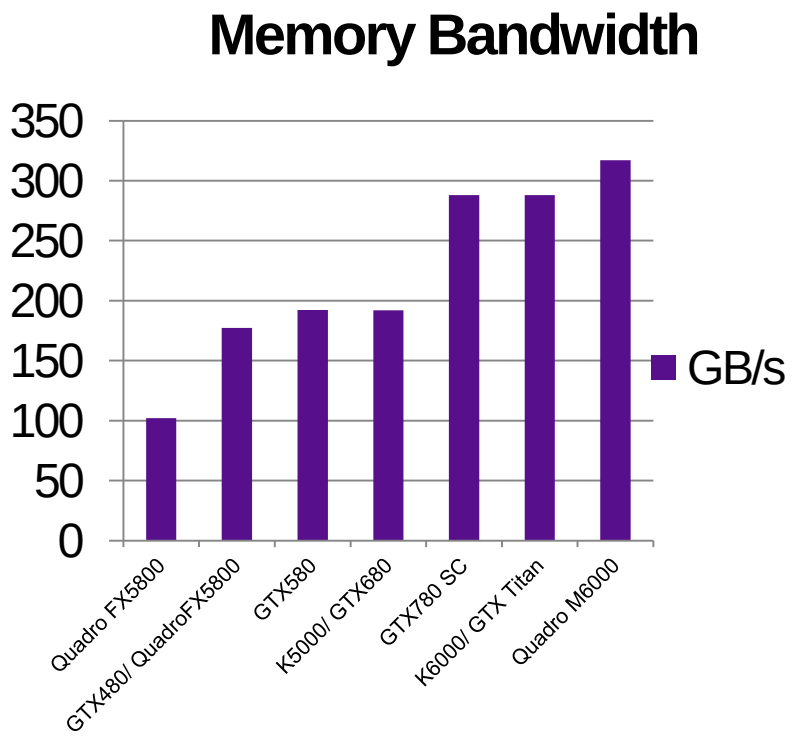
History (Recent) NVIDIA GPU Performance





Boeing Simulation benchmark

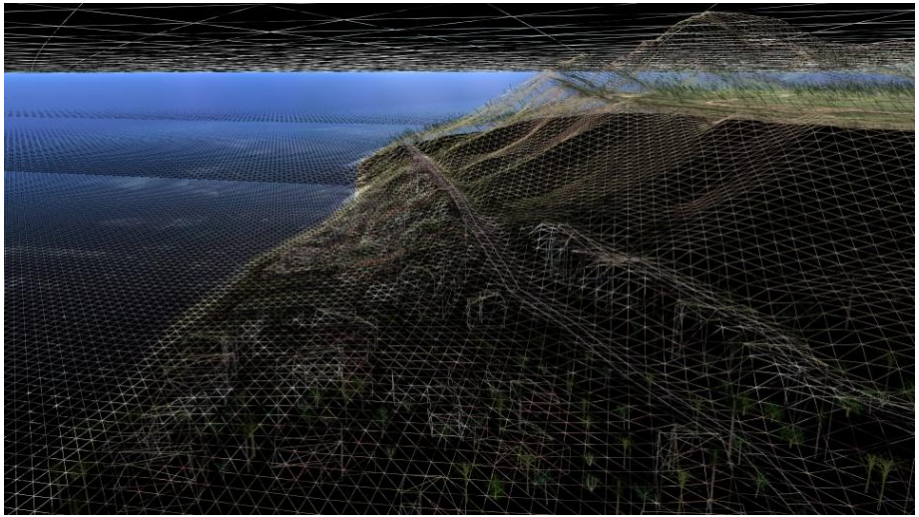
GPU Memory Bandwidth history



- GPU memory speed performance allowing high fill rates.

Dense Content: Elevation

- Topography quality
- Current GPU performance allows complex terrain skin
- Terrain skin tessellation smoothing



Dense Content: Imagery

- Satellite imagery issues

Dense Content: 3D Buildings

- Accurate complex models
- Current GPUs texture memory and geometric performance allows use of accurate complex models

Dense Content: Trees

- Wide area placement

Dense Content: Roads

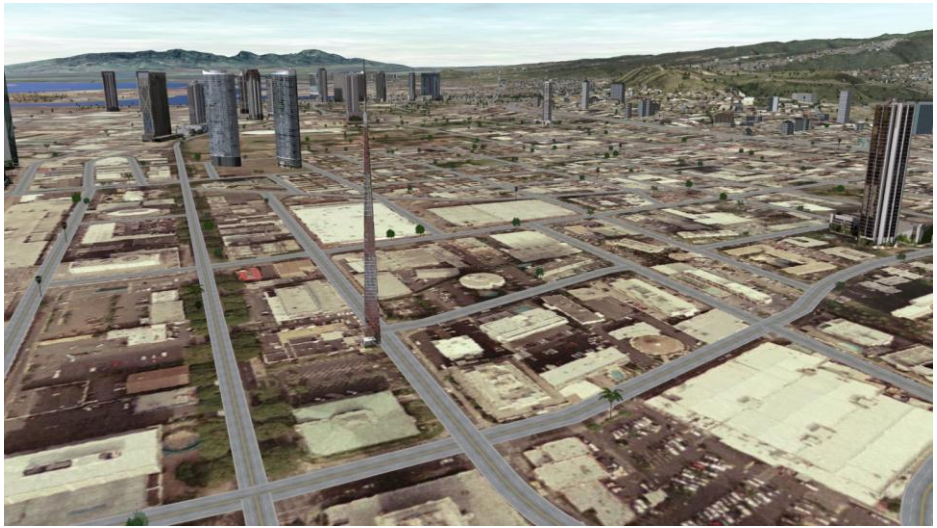
- Polygonal roads
- Accuracy as good as source
- Moving models

Dense Content: Shadows

- Full scene cast shadows

* Current GPU polygonal performance and fill allows full scene shadows

Performance: Then and Now



- Pre-Fermi
- Low 3D Building Densities
- Low Tree densities

Dense Content: High/Medium Altitude

- Pre-Fermi Example
- High altitude example

- Moving Models to terrain
- Dynamic realism

Medium Altitude dense culture

- Distance Cueing
- Time of day differences

Realism: On Ground

- Pre-Fermi
- No shadows
- Lower density culture

- 3D ground culture
- Full scene cast shadows
- Winds

Geo-typical Buildings

- Dense
- Less immersive
- High performance

Realism: Night

- Light pools
- Light points
- Windows

Realism: Night

- GPU polygonal performance allows large numbers of light points, accurate city illumination
- Global coverage from source

Rendering Frame Budgeting (fixed frame rate)

Scene element
Terrain skin, Atmosphere
3D buildings
Trees
Roads
Cast shadows
Entities
Lighting
Particle effects
Clouds: Volumetric and Layered
Fog deck

- **Maintain frame rate 60Hz**
  - Include all requirements
  - Understand cost of each element
  - Test for all requirements
  - Ensure system performance (full system test procedures)

Conclusions NVIDIA GPU performance

- GPU performance allows dense culture rendering with cast shadows
- Visual Simulation content quality is ramping in realism
- GPU performance increases measuring 20% per year since Fermi series
- New generation cards: exceeding 20% increase

NVIDIA GPU performance increases have significantly improved immersion in training systems

References

[1] Krista Langkamer Ratwani, Webb Stacy, Alexandra Geyer, Scott Pappada, and Emily Weise
"Evaluating Immersion in Training Environments"
Interservice/Industry Training, Simulation, and Education Conference (I/ITSEC) 2012

[2] Randall Garrett, PhD
"To Believe or Not to Believe, Fidelity is the Question"
Interservice/Industry Training, Simulation, and Education Conference (I/ITSEC) 2012

[3] Ms. Jamie L. Estock, Ms. Kathryn Baughman, Dr. Emily M. Stelzer, Dr. Amy L. Alexander,
"Fidelity requirements for effective training:
Pilot perceptions versus objective results"
Interservice/Industry Training, Simulation, and Education Conference (I/ITSEC) 2008

[4] Paone, William
"COTS Image Generation in Immersive Systems: Design, Acceptance and Production: A Tough Experience"
IMAGE Conference 2013

Content and Rendering

- Diamond Visionics: Genesis IG and Genesis RTX Visual Run-time software
- Diamond Visionics: Hawaii source: imagery, shapes, tree points.
- PLW Modelworks: 3D Urban Models, Hawaii, OpenFlight

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