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GPU-Based Scene Generation for Flight Simulation

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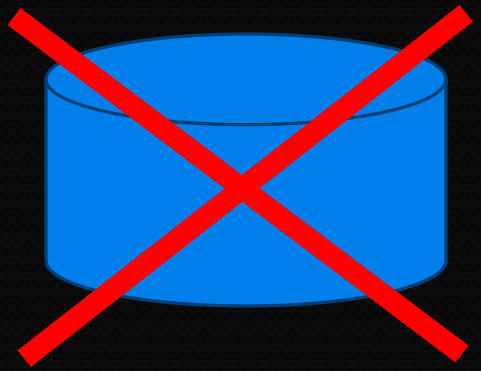
Traditional Scene Generation

- Database Generation
  - Pre-compile LODs



- Image Generation
  - Hierarchical scene graph

Approach used by most geo-spatial visual systems

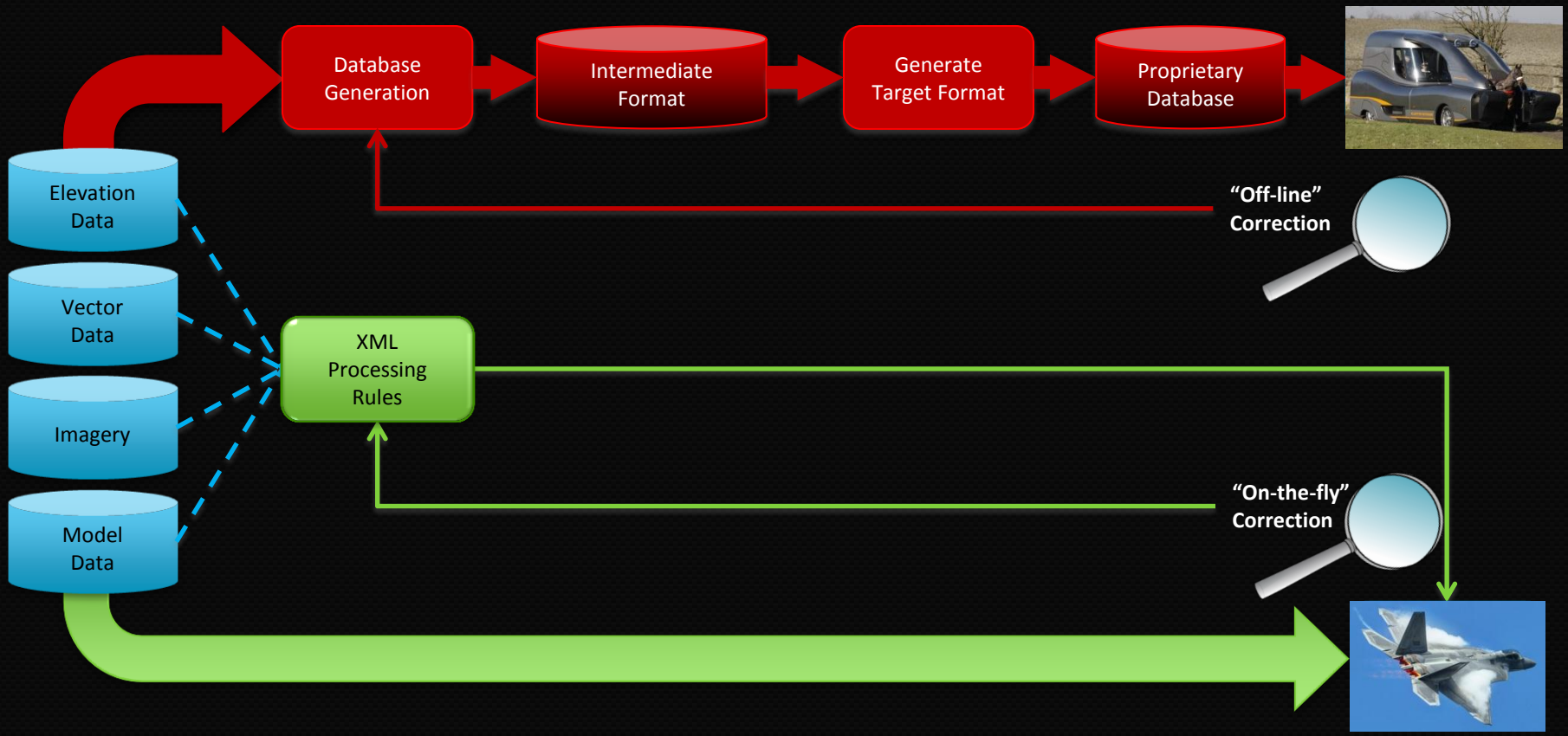
How can we optimize these two areas and leverage the GPU?

Eliminate both!

Flight Simulation vs. Gaming

- Instructor-controlled conditions (time, clouds, fog, etc.)
- 20+ channels
- No aliasing
- No Z-fighting
- No LOD popping
- Subjective tuning
- ***Never*** drop frames
- **LARGE** “gaming” areas

Process: from Source to Scene



You’re doing it wrong

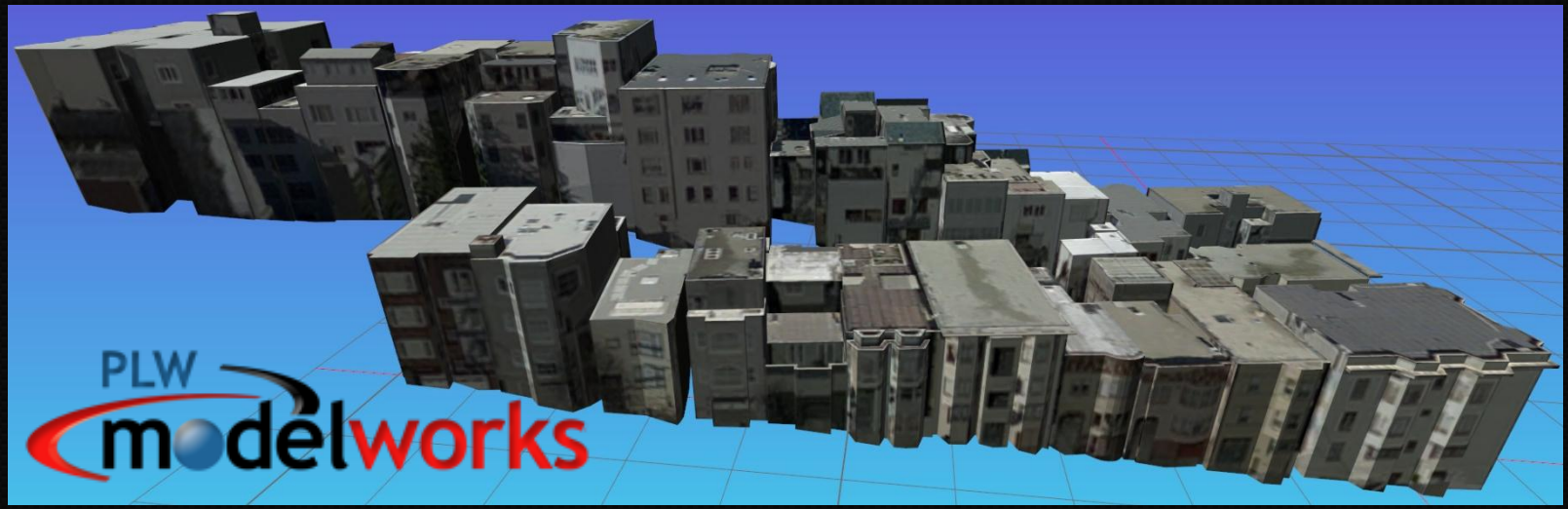
- Pre-compute LODs for all possible paths into “polygon soup”
- Very little of the result is typically used
- Uses tremendous computing resources
- Uses tremendous amount of storage space

Much better…

- On-the-fly construction of LODs
- Highly parallelized CPU
- Construction targets GPU for optimal performance
- Uses minimal amount of storage space

San Francisco Dataset Statistics

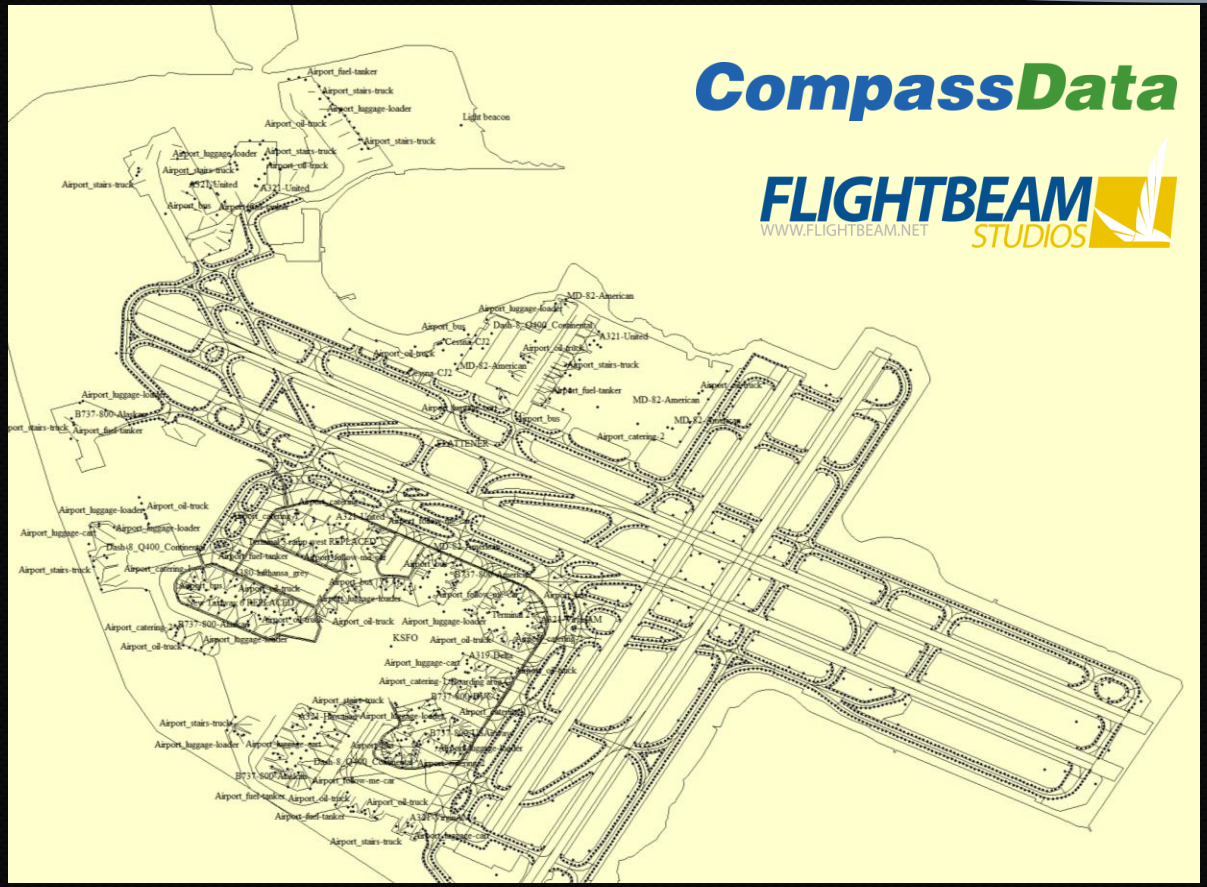
- Quadro M6000 stress test – expected result: 30% speedup
  - Over 85K 3D models, 13.5M polys
  - Over 4 GB of compressed textures



San Francisco Dataset Statistics

- All the roads in CA
- Light points and pools generated for all of them

SFO Vector Features



Scalable with GPU Advancements

- Quadro M6000 over 100% faster than K6000!
- Applying modern OpenGL
  - 75% reduction in draw calls by using bindless and MDI
  - 2.5+ ms / frame CPU time reduction
- Still more room for improvement
  - 99% reduction by using NV_command_list
  - 8+ms / frame CPU time reduction
- Typical results
  - `CPU:  9.8 -> 7.2 = 1.4x speedup`
  - `GPU: 13.8 -> 6.1 = 2.2x speedup`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Questions?

Related talks:

- S5135 – GPU-Driven Large Scene Rendering in OpenGL
- S5258 – Dense 3D Culture Rendering using NVIDIA Solutions in Immersive Fast-Jet Simulators
- S5142 - See the Big Picture: Scalable Visualization Solutions for High Resolution Displays
- S5451 - The Graphics Debugger for Linux

Exhibit hall: PNY and Concurrent

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