Introduction to Graphics Programming and its Applications

繪圖程式設計與應用

Appendix: OpenGL Learning Resources

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OpenGL Wiki

- Best guide in this world, in my opinion ☺
  - https://www.khronos.org/opengl/wiki/Main_Page
- Read this and you will learn everything
  - Almost. Some pages under construction…
- Pages you MUST read:
  - OpenGL Common Mistakes
  - We will have a QUIZ coming from this page ☺

OpenGL Tutorials

- Google “OpenGL Tutorials” gives you a full list
- Recommended:
  - https://learnopengl.com/
  - http://ogldev.atspace.co.uk/
  - http://www.opengl-tutorial.org/
  - http://www.lighthouse3d.com/
- Please avoid pre-OpenGL 3.0 tutorials
  - DON’T http://nehe.gamedev.net/

Useful Libraries

- AntTweakBar
  - http://anttweakbar.sourceforge.net/doc/
  - Add GUI to tweak algorithm parameters
- Assimp
  - http://assimp.sourceforge.net/
  - Import all kinds of 3D models/scenes/animations
- stb header only libraries
  - https://github.com/nothings/stb
  - Many useful header only libraries
  - Recommend: stb_image, stb_image_write

Useful Libraries

- tinyobjloader
  - https://github.com/syoyo/tinyobjloader
  - Load Wavefront OBJ 3D models
- tinyexr
  - https://github.com/syoyo/tinyexr
  - Load/save OpenEXR images
- glm
  - http://glm.g-truc.net
  - Math library
- Eigen
  - http://eigen.tuxfamily.org
  - Math library

Profiler

- Understanding performance issues
- CodeXL
  - http://gpuopen.com/compute-product/codexl/
  - AMD supported
  - Visual Studio Plugin
- NVIDIA Nsight
  - http://www.nvidia.com/object/nsight.html
  - Visual Studio Plugin
  - Only works on NVIDIA GPUs

OpenGL Books

- I would recommend OpenGL Wiki & tutorials, but since you asked…
- OpenGL Programming Guide 8th
  - Red Book
  - Link
- Please avoid OpenGL SuperBible
  - Not too bad, but not so good

OpenGL 4.5?

- Do I need to learn it?
  - Yes if you are writing a lot of OpenGL
  - Direct State Access makes things a lot more obvious and easy to program
  - It is, in fact, very easy to learn if you have mastered OpenGL 3.1
  - No quality tutorials in OpenGL 4.5 around ☹
  - Bigger problem: does your graphics card support it?

WebGL & OpenGL ES?

- Do I need to learn them?
  - Subset of desktop OpenGL
  - You'll learn more about "limitations", not "possibilities"
  - Core philosophy is the same anyway
  - Recommended only if you are using them in real applications

Direct3D and Vulkan?

- Do I need to learn them?
  - Yes if you are trying to get a job in this domain ☺
  - Learn them if 1 ms have great impact on your application (games, VR, etc…)
  - Having a look at them may actually helps
  - You are programming the SAME GPU anyway
  - Not so different ☺
  - Recommended book: Link

What's Next?

- **How:** graphics APIs are ways to use the GPU
  - You are here
- **Why:** solving real time rendering problems is your GOAL by using them
- **What:** domain knowledge in 3D computer graphics, game rendering, VR rendering, archvis rendering…
  - You need to learn these (in the industry)

Domain Knowledge?

- Roughly two categories
  - Performance
  - Special Effects
- Performance
  - Multi-threaded rendering
  - Memory management
  - Accelerating data structure & algorithm, etc…
- Special Effects
  - Global Illumination
  - Physically Based Simulations
  - Animations, etc…

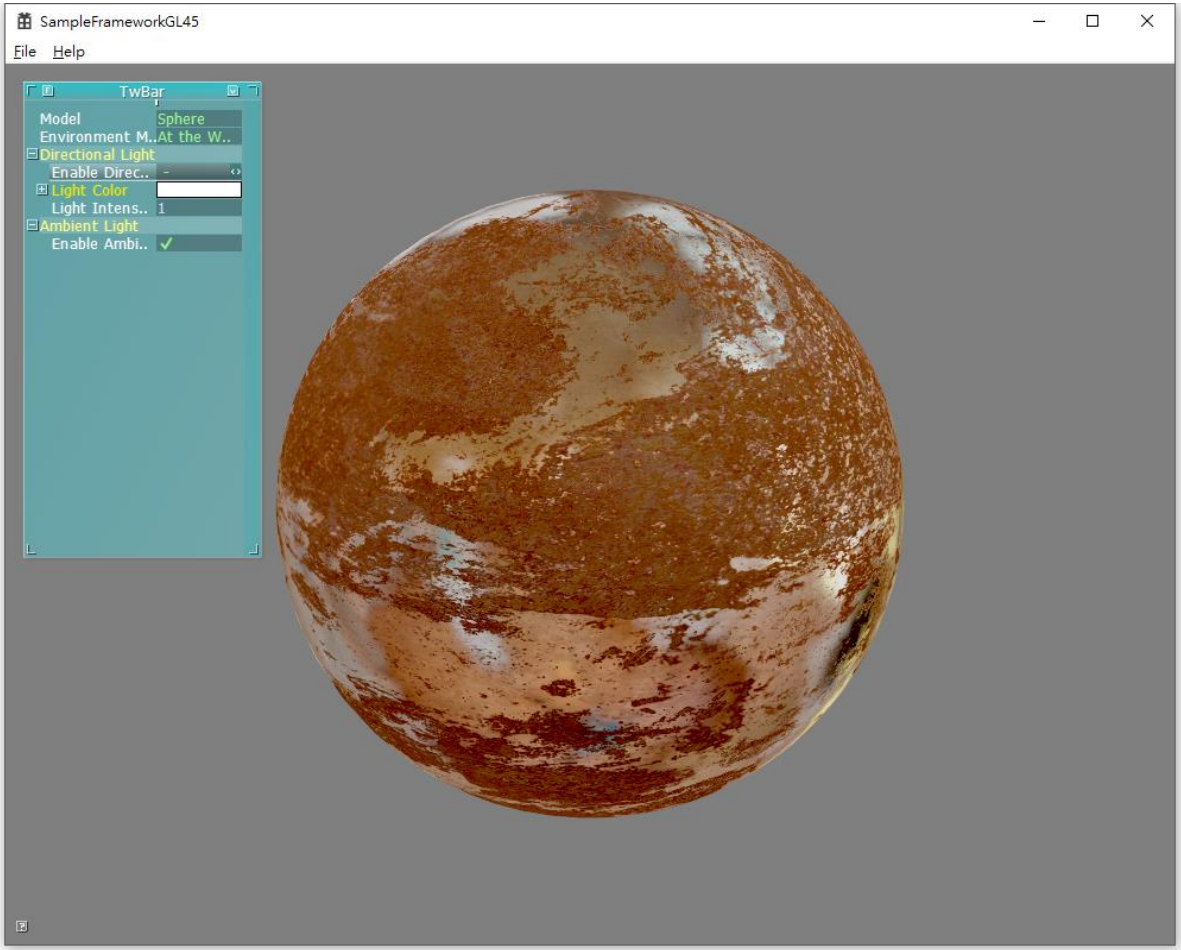
Way to Go

- How to do these practically?
- Three goals in mind

Goal (1): Sample Framework

- Solid and flexible framework to quickly implement any ideas or techniques learned
- You can refer to MJP's samples: Link
- Must-haves:
  - GUI to adjust parameters (AntTweakBar)
  - Libraries to load 3D models/images (Assimp/stb)
  - Common Data Structures/Utilities
    - Bounding Volumes, Camera, Timer, FileIO, etc…
  - Graphics code libraries
    - CreateTextureFromFile, CompileShaderFromFile, etc…

Goal (1): Sample Framework



Goal (2): Bag of Tricks

- Establish your base of knowledges
  - I use Evernote (web clipper) + Pocket
  - Pocket to trace forum threads
- Stay tuned to
  - Graphics Programmer Blogs (selfshadow)
  - Online Forums (gamedev.net)
  - GDC talks (GDCVault)
  - SIGGRAPH courses (selfshadow)
  - SIGGRAPH/I3D papers, etc…

Goal (2): Bag of Tricks

- “How did you built a rocket?”
- Elon Musk: “I read books”
- Real-Time Rendering
  - http://www.realtimerendering.com/
  - Must Read
- Physically Based Rendering
  - http://www.pbrt.org/
  - More about offline rendering

Goal (3): Problem Solving Skills

- Harder to tell ☹
  - This might give you some thought: Link
  - Try to think and implement by yourself
  - Try different fields in computer graphics
  - Try to solve problems unsolved

Rendering Dropbox

- I am hosting a public dropbox with resources gathered
- Updating it constantly (if I have the time)
- Write to unlin@livemail.tw I can give you a read-only access
- Take a look then build your own!