Considerations for Building SfM Machines for Use With Agisoft PhotoScan

2016 Short Course: Imaging and Analyzing Southern California's Active Faults with high Resolution Topography

January 26, 2016

Barrett Salisbury

UPDATE by Arrowsmith and Mackenzie March 2016

Outline

- General Introduction
- Main Questions
  - Multi-Core CPU Performance
  - GPU Acceleration
- In-House Comparisons

- →Really it is what you choose to process that matters more than the power and need to know what you want out of it

Introduction - Definitions

- Motherboard – the main circuit board that facilitates communication between components (e.g. the CPU/GPU and memory).
- CPU – Central Processing Unit, carries out instructions of computer program
  - Frequency - # of operations/second
  - Number of Cores – how many operations it can run simultaneously
- Memory (i.e. RAM) – random access memory, used to store information for immediate use
- GPU – Graphics Processing Unit, specialized electronic (parallel) circuit for manipulating memory to accelerate creation of computer graphics and image processing, usually present in video card. Each GPU may contain multiple cores.

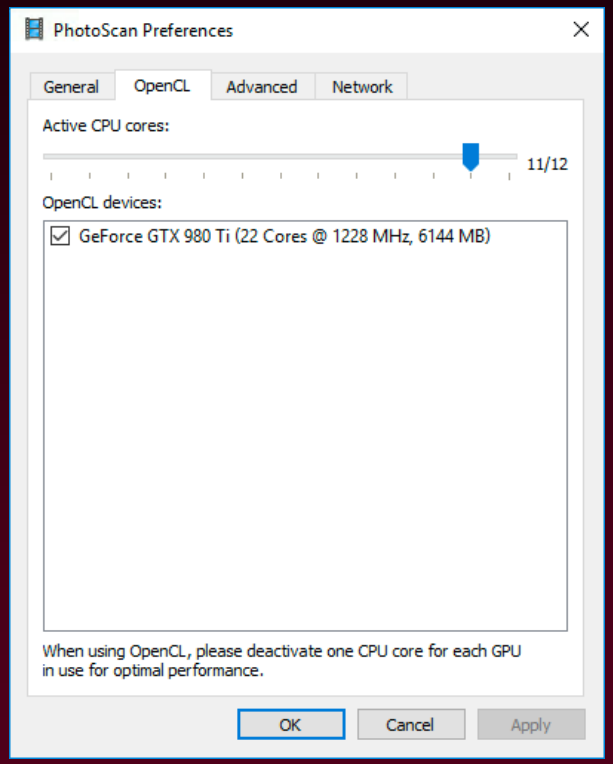
- For PhotoScan, CPU and video card (GPU) are most important

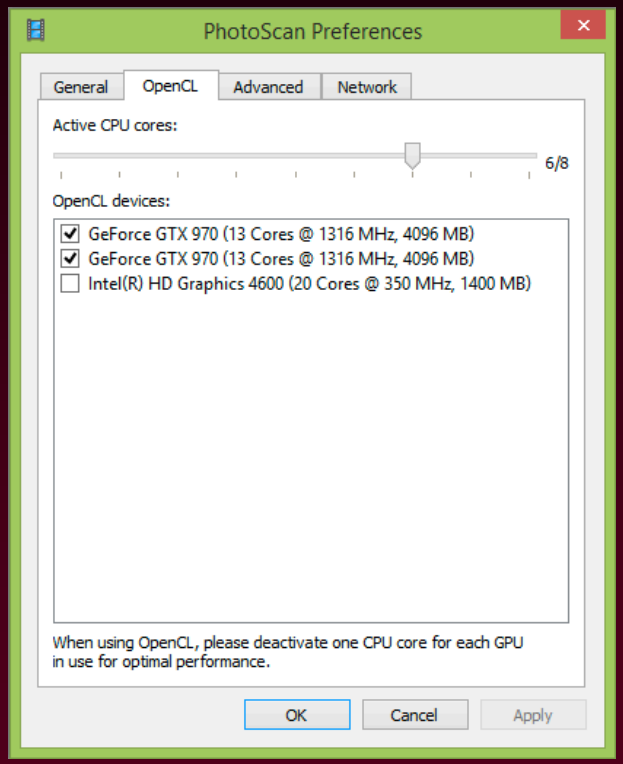
Agisoft PhotoScan

- How well can PhotoScan use multiple CPU cores?
- What is the best core configuration (if more than one CPU)?
- What effects does GPU processing have on the CPU?

Build	Machine Name	CPU	GPU	RAM
Nov-15	Skylake	Intel i7-5930K (12 cores)	GeForce GTX 980 Ti (22 cores)	32 GB (4x 8GB)
Jan-15	Polygon	Intel i7-4790K (8 cores)	2x GeForce GTX 970 (2x 13 cores)	32 GB (4x 8GB)
Jun-14	Pele	Intel i5-4670 (4 cores)	GeForce GTX 780 (12 cores)	32 GB (4x 8GB)

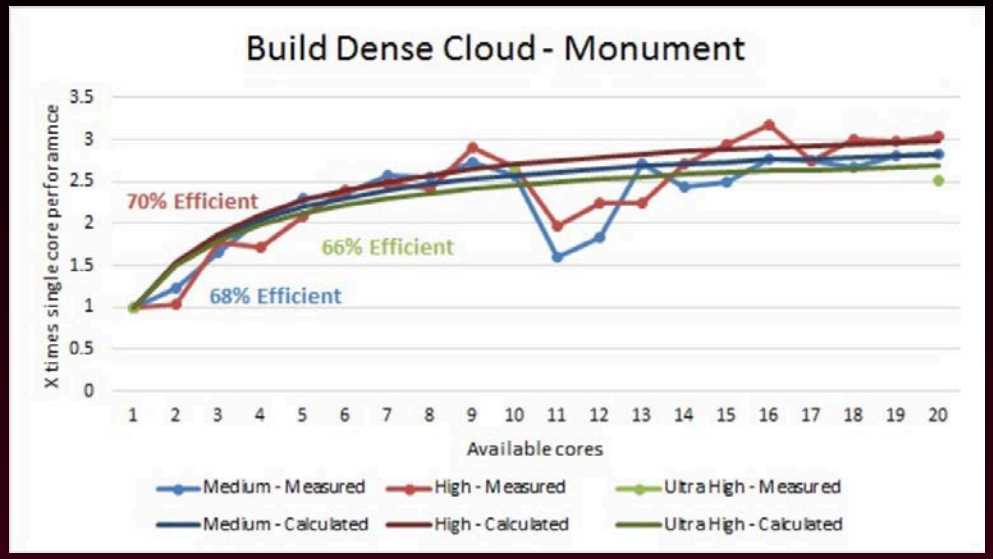
CPU / GPU tradeoff





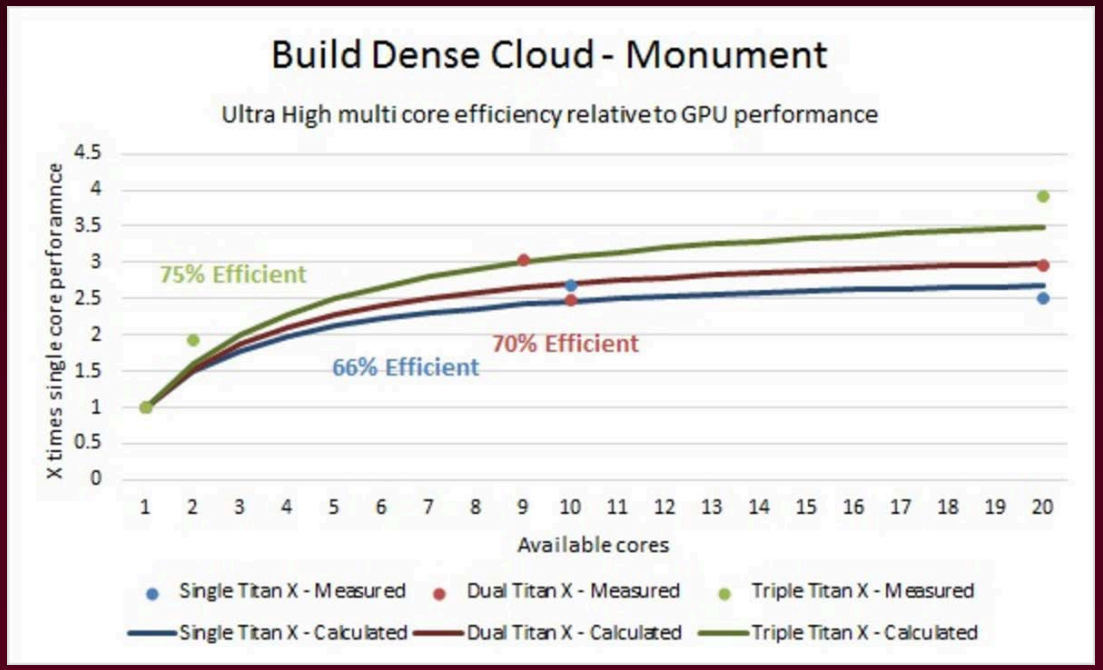
1. Align Photos
2. Build Dense Cloud*
3. Build Mesh
4. Build Texture

*Not the case for VisualSfM



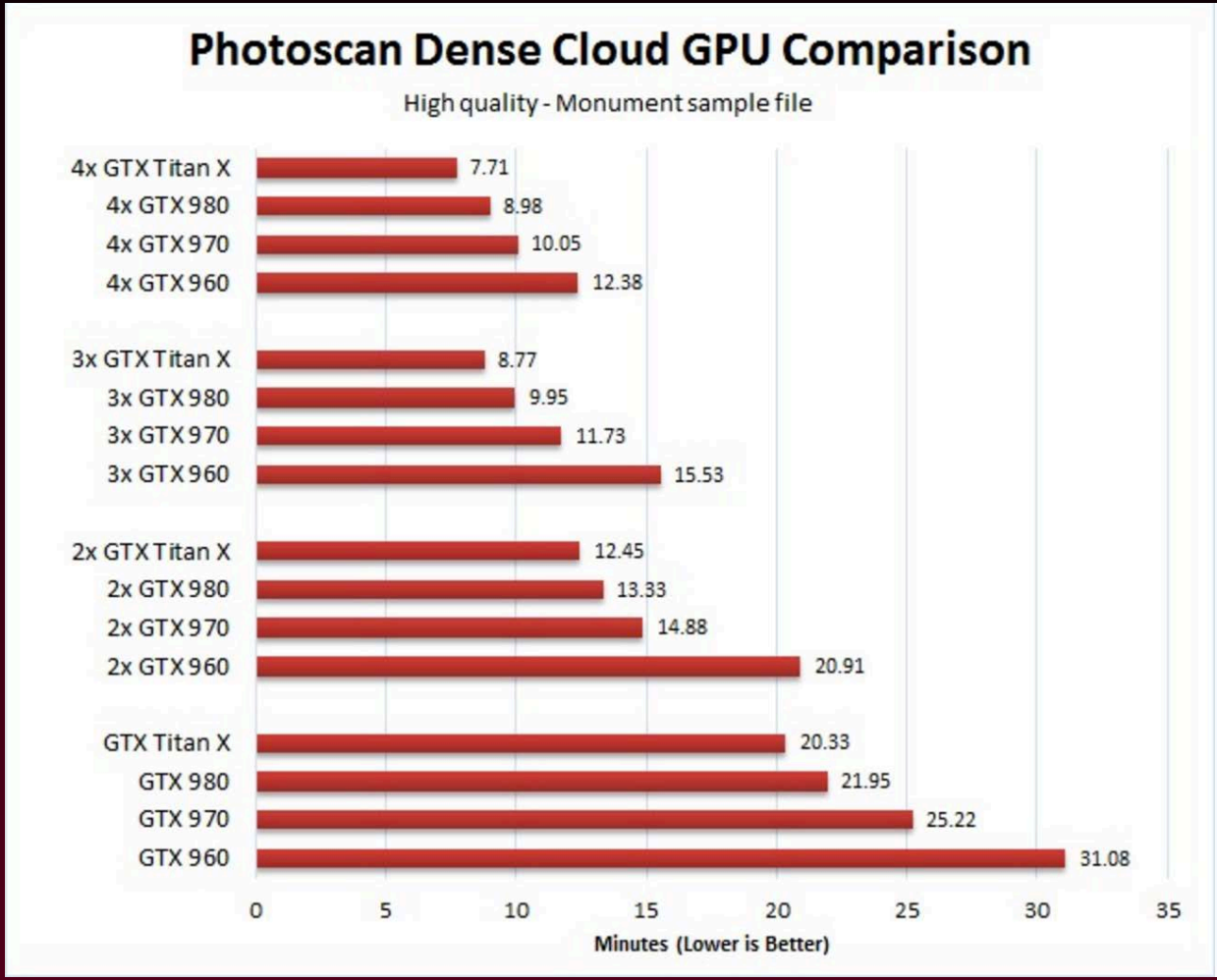
2x 10-core CPU's

Multi-Core CPU efficiency



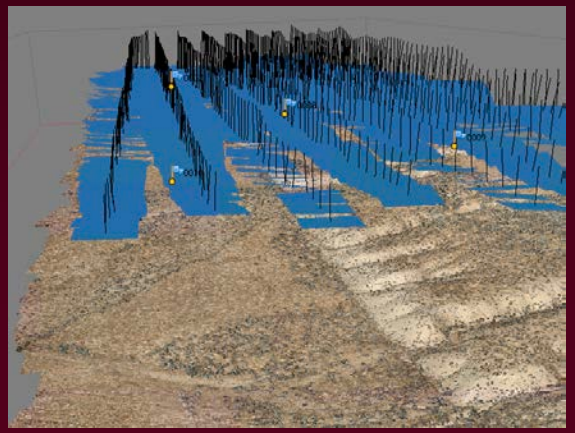
Effects of multiple GPU Cores on CPU performance

https://www.pugetsystems.com/labs/articles/Agisoft-PhotoScan-Multi-Core-Performance-709/



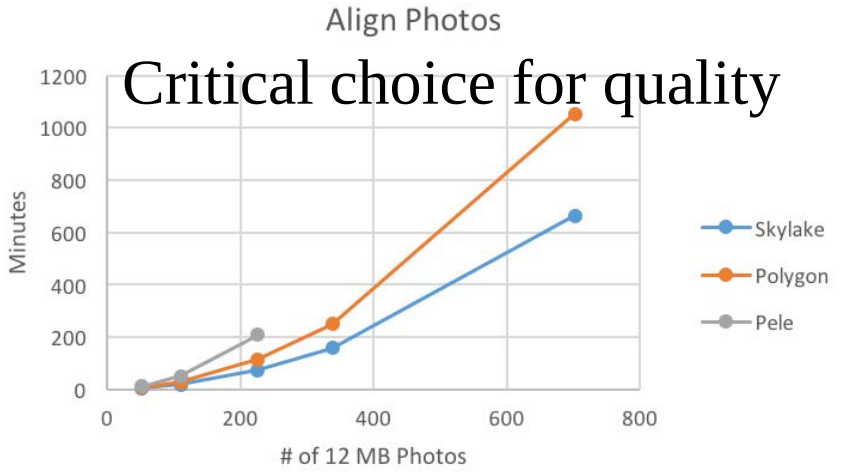
https://www.pugetsystems.com/labs/articles/Agisoft-PhotoScan-GPU-Acceleration-710/

Our comparisons

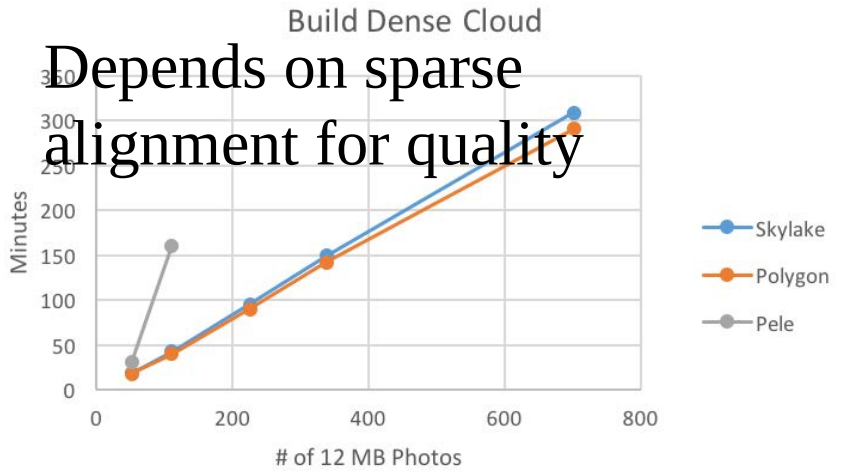


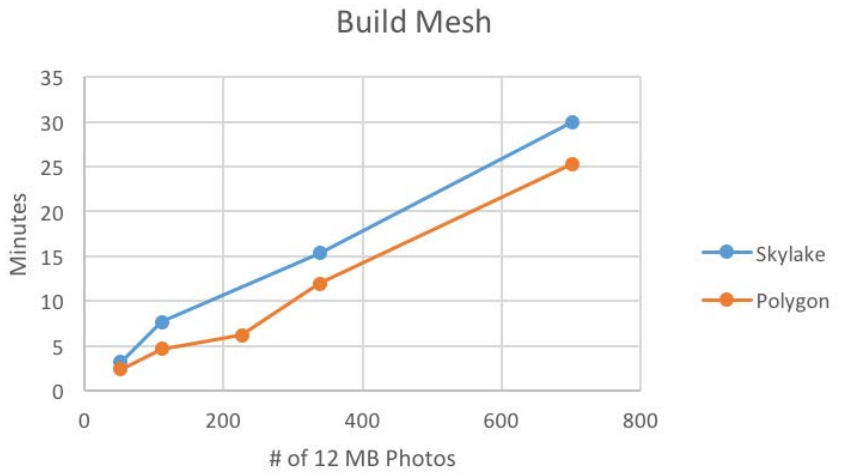
Build	Machine Name	CPU	GPU	RAM
Nov-15	Skylake	Intel i7-5930K (12 cores)	GeForce GTX 980 Ti (22 cores)	32 GB (4x 8GB)
Jan-15	Polygon	Intel i7-4790K (8 cores)	2x GeForce GTX 970 (2x 13 cores)	32 GB (4x 8GB)
Jun-14	Pele	Intel i5-4670 (4 cores)	GeForce GTX 780 (12 cores)	32 GB (4x 8GB)

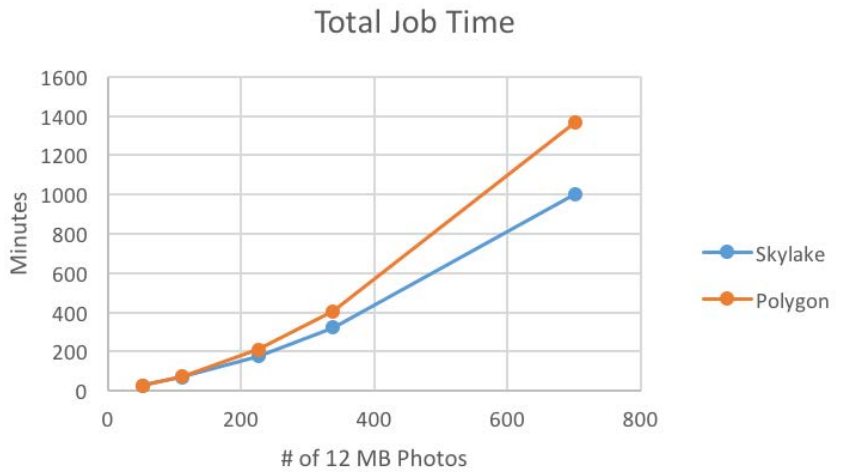
Critical choice for quality



Depends on sparse alignment for quality







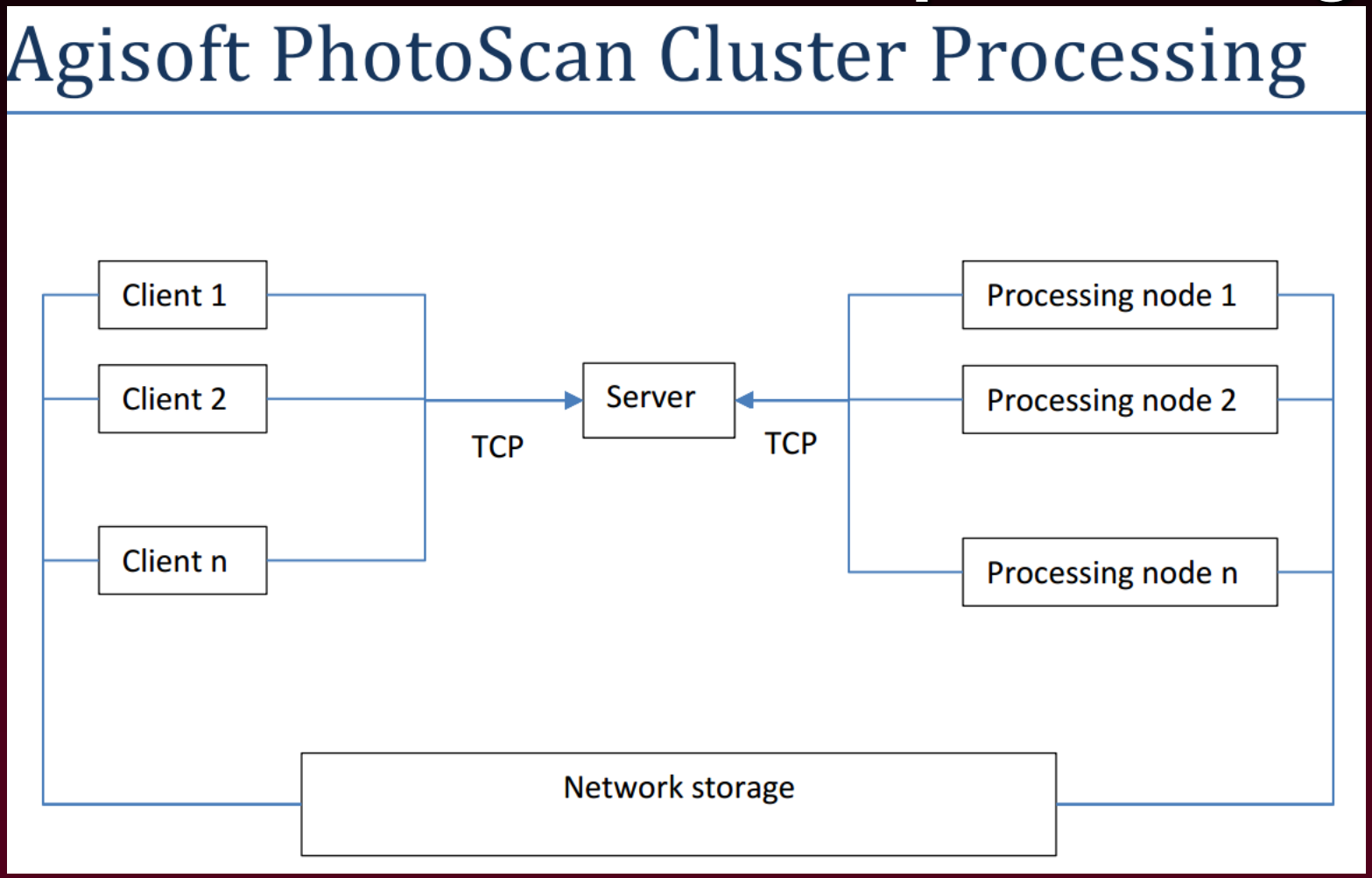
Take-home

- As you increase number of GPU cores, multi-core CPU efficiency increases by ~5% per GPU. Important because CPU used in ALL processes
- For every physical GPU in the system, you must disable one CPU core. 2 GPU's, 30-40% increase, 3rd GPU, additional 20-25%, 4th GPU, additional 10-15%, for DENSE CLOUD ONLY
- As you add GPU cores, you want a higher CPU core count for best performance
- Because high core-count CPU's are expensive, you must balance purchasing multiple video cards (main performance gains here) with more expensive high core count CPU to match
- When choosing video cards, more is better, provided you have the CPU cores to match. Two (or more) mid-range video cards are better than one highest-quality video card.
- If multiple CPU's, avoid transferring data to an under-utilized second (or third) CPU

David Mackenzie addition

- CPU cores are a must and GPU is needed but no need for fanciest because Dense cloud is not limiting step
- Keeping up with Photoscan updates

Photoscan network processing



http://www.agisoft.com/pdf/photoscan_network_processing.pdf

Networked SfM

- Thin client on desktop (for visualization)
- Linux-based networked servers with core server runs process then distribute on the network (each needs license)
- Requires PSX format for file structure
- Iteratively increase quality and geometry
- Go up to thousands of photos

Visualization and surfaces

- Data structure k-tree is needed for big datasets
- Photoscan is pretty good
- Also LidarViewer—points and Crusta – DEMs (KeckCaves)
- CloudCompare ok for small datasets
- Aesthetics of Photoscan mesh/DEM are lacking so grid outside (GMT—blockmean plus surface (spline—fast!) or LASTOOLS--tin)
- Need to be aware of floating point