



See the world with different eyes





51st Photogrammetric Week





See the world with different eyes

Performance improvements of digital photogrammetric systems

•Review

•Changes in computing performance

Parallel/distributed processing/computing

•Example

Prospects





Review - project size

Number of photos in production per company

- 1997 10000 20000 photos
- 2007 200000 photos
- example for large project in 2006:

Los Angeles County 3 DMC cameras 60500 images + LIDAR final products: 10 cm pixel orthos , 2 foot contours (see: ASPRS 2007, G. Sehnalek, N. Franchino)





Increase in productivity

main contribution:

- new digital sensors (large and medium format)
- direct Georeferencing (GPS and IMU)
- Changes in computing performance (storage and processing)







images on the Internet





www.virtualearth.com

www.google.com





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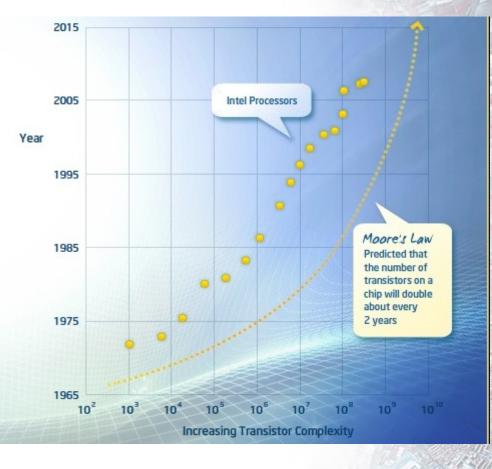




Moore's Law

Moore's Law

In 1965, Intel co-founder Gordon Moore predicted that the number of transistors on a chip would double about every two years. Since then, Moore's Law has fueled a technology revolution as Intel has exponentially increased the number of transistors integrated into its processors allowing greater performance and energy efficiency.



Ref: www.intel.com

>) Jump to Timeline





Intel

1981 - 6 Mhz 134 000 Transistors

1989 - 25 Mhz 1,2 Mio.

2000 - 1,5 Ghz 42 Mio.

2007 - 2,6 Ghz 582 Mio.

Intel 286 Intel 486 Intel Pentium IV

Intel Core 2 Quad Processor

End of 2007 Intel 8 core systems

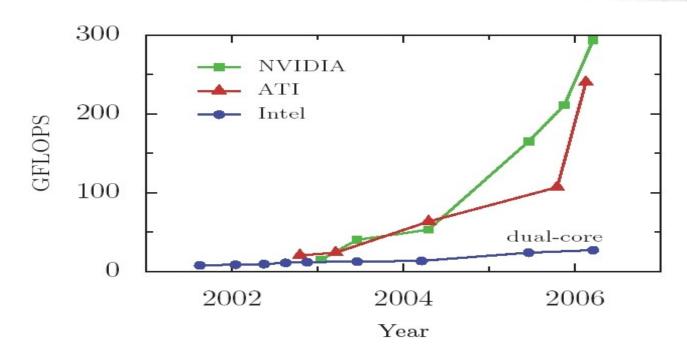
Need: Support of multi core architecture





GP-GPU

• General – Purpose computation on Graphics Processing Units

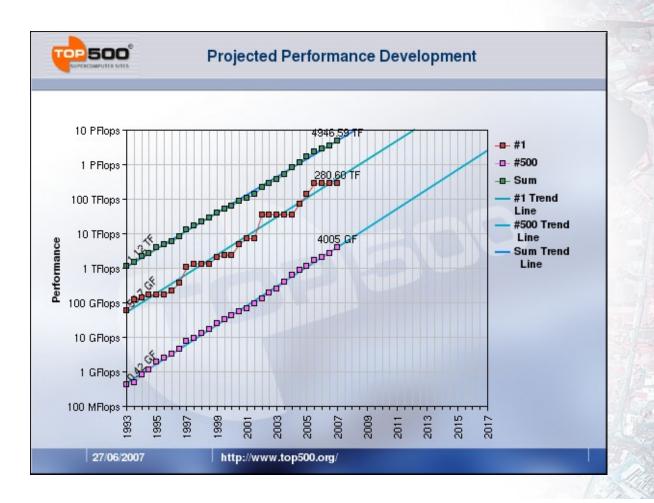


Ref:Owens, Luebke, Govindariju, Harris, Krüger, Lefohn, Purcell, A Survey of General Purpose Computation on Graphics Hardware Computer Graphics Forum, Volume 26 (2007), number 1 pp. 80 - 113





Тор 500







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better performance

how to get there at customer's production:

... it runs twice as fast every 18 months with no change of code...

Enhance software to take advantage of new hardware

- Better utilization of available customer's hardware
- Use complete potential of multi-core architecture

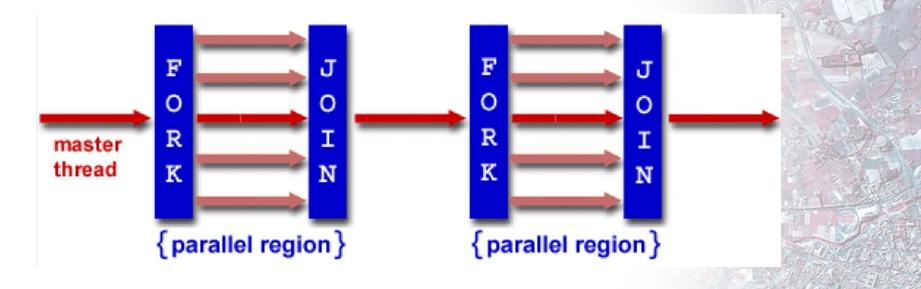




Parallel execution in software

usage of multi core hardware:

- OpenMP for shared memory (SMP) systems:
- fork / join model



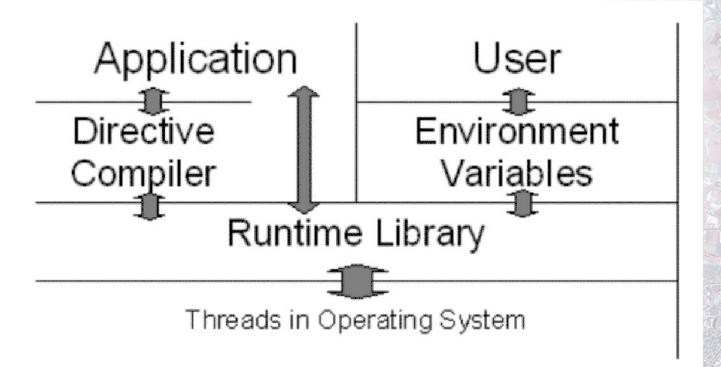
http://www.openmp.org





Open_MP Architecture

- Multi-Platform shared-memory parallel programming
- Specification 2.5 May 2005
- Supported by all major compiler



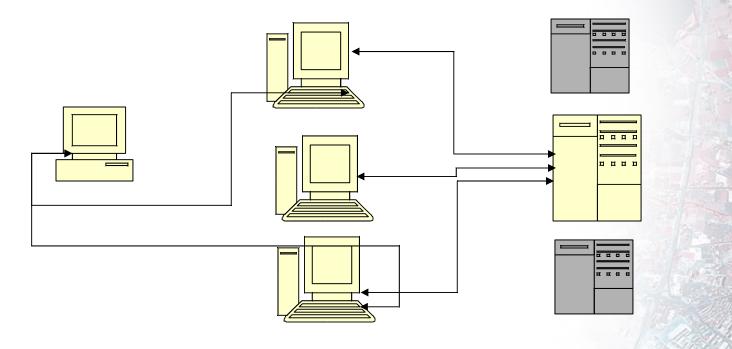




better workload on customer's IT

better utilization ratio of available hardware:

→ distribute/share tasks to/with different computer







Work load management systems

Open source:

Portable Batch System (or simply PBS)

- OpenPBS the unsupported original opensource version
- TORQUE Resource Manager (Terascale Open-Source Resource and QUEue Manager) an open source fork of OpenPBS version 2.3.12 maintained by Cluster Resources.
- Sun Grid Engine (SGE), previously known as CODINE (COmputing in Distributed Networked Environments) or GRD (Global Resource Director), an open source batch-queuing system, supported by Sun Microsystems.
- Condor is a software framework for coarse-grained distributed parallelization of computationally intensive tasks





Commercial systems

commercial :

- Load Sharing Facility (or simply LSF) is a commercial computer software job scheduler sold by Platform Computing
- Sun also sells a commercial product based on SGE, known as N1 Grid Engine (N1GE).
- PBS Professional (PBS Pro) an enterprise-quality professional version maintained and sold commercially by Altair Engineering
- others





Ideal workload on 8 core system

Options Vie	w негр		THE STATE
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Memory	Physical Men	ory Usage History	
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Cached	2743	Threads 1053	
Free	8	Processes 61	
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Paged	168	Resource Monitor	
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Example 1a: OrthoMaster - DPMaster

Distributed Processing Master ID Owner Priority Remote Host Status Time Command <u>N</u>ew... C:\InphoTest\PhoWo.prj <u>E</u>dit... 😑 - 380 ckriea 5 vm1@des-eowin.eu.trimblecorp.net Running 29/08/2007 - 03:37 pm (running for 00:03:20) C:\WINDOWS\syste... · 0 - 1 ckrieg 5 vm2@des-eowin.eu.trimblecorp.net Running 29/08/2007 - 03:37 pm (running for 00:03:16) C:\WINDOWS\syste... <u>V</u>iew... ckrieg 5 undefined Idle 29/08/2007 - 03:37 pm C:\WINDOWS\syste... 2 Idle 3 ckrieg 5 undefined 29/08/2007 - 03:37 pm C:\WINDOWS\syste... Remove undefined Idle C:\WINDOWS\syste... ckrieg 5 29/08/2007 - 03:37 pm 4 5 ckrieg 5 undefined Idle 29/08/2007 - 03:37 pm C:\WINDOWS\syste... Held - via condor hold (by user ckrieg) C:\WINDOWS\syste. ckrieg undefined 29/08/2007 - 03:41 pm Close Filter job list by Remote Host





Example 1b: New job

New Job								?×
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Select job settings and de	fine requirements fo	or the distribut	ed processing.					
Collinea								
Settings								
Priority: 5								
Machine requiremen	ts							
Operating system:	Windows XP - (def	ault)		(~			
Architecture:	Intel x86 CPU - (default)				~			
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?

Example 1c: view job

33 View Job - [380.6]

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				Ilose





Example 2a: ADS On the fly L1







Example 2b: ADS On the fly L1





Example 3: Automatic Triangulation

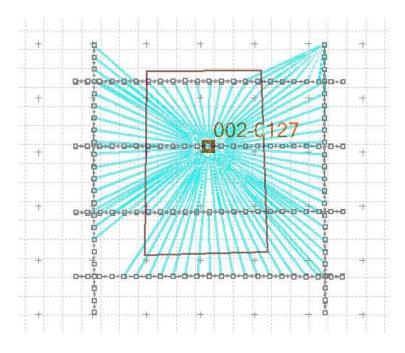
- Simulated data, large block size
- 10000 images 50 strips, 200 images each
- 225 image observations, per image
- 10000 GPS + IMU
- 2.5 Mill. image points
- 1,5 Mill. unknowns
- ca. 0,5 Mio. block points
- Adjustment MATCH-AT: 17 minutes / iteration
- → need for parallel processing of matching

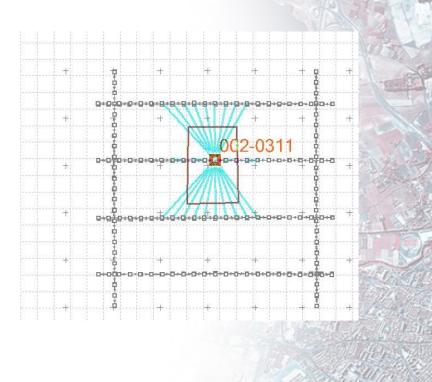






Example 4a: block with extreme overlap



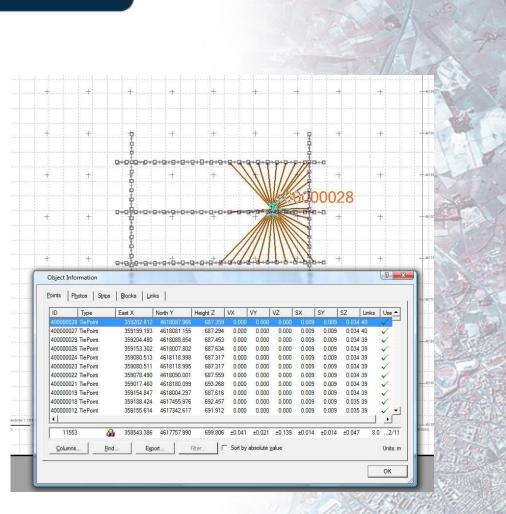






Example 4b: block with extreme overlap

• points in up to 40 images:







Example 5a : MATCH-T DSM

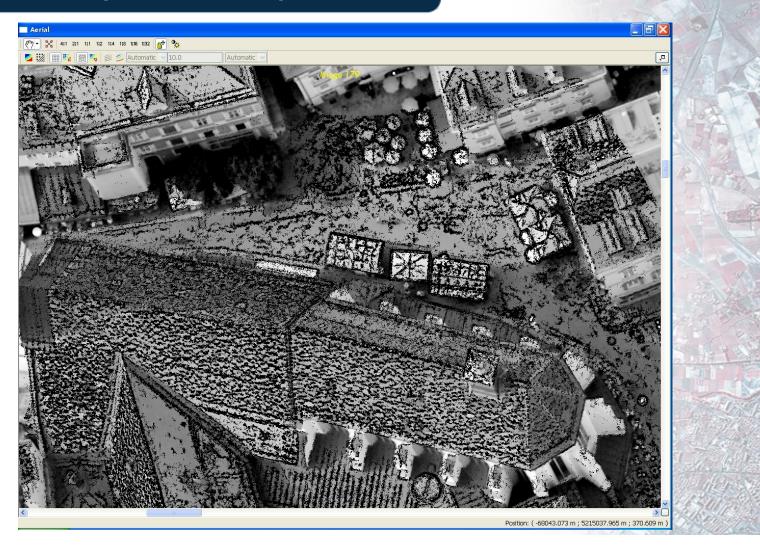
- Creation of DSM point cloud with UltraCam images
- 80/60 overlap
- 10 cm GSD







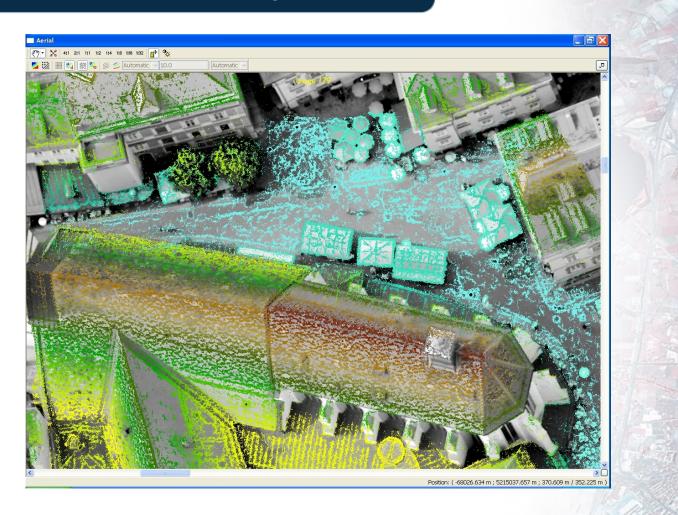
Example 5b : DSM point cloud







Example 5c : DSM colored point cloud







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- Distributed processing
 - Already in use at customer's productions shops
 - INPHO introduces DPMaster for OrthoMaster and MATCH-T
- Need for adapted algorithms to run on parallel (multi-core hardware)
 - Different technologies for implementation, Open_MP platform independent
 - Multi core architecture will evolve in next years
- additional source processing power: GPU (graphic process. unit)
 - GPU development faster then CPUs in last 3 years
 - Different programming model only special task can run on GPU





For further information, please visit INPHO's demo in room E and F

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