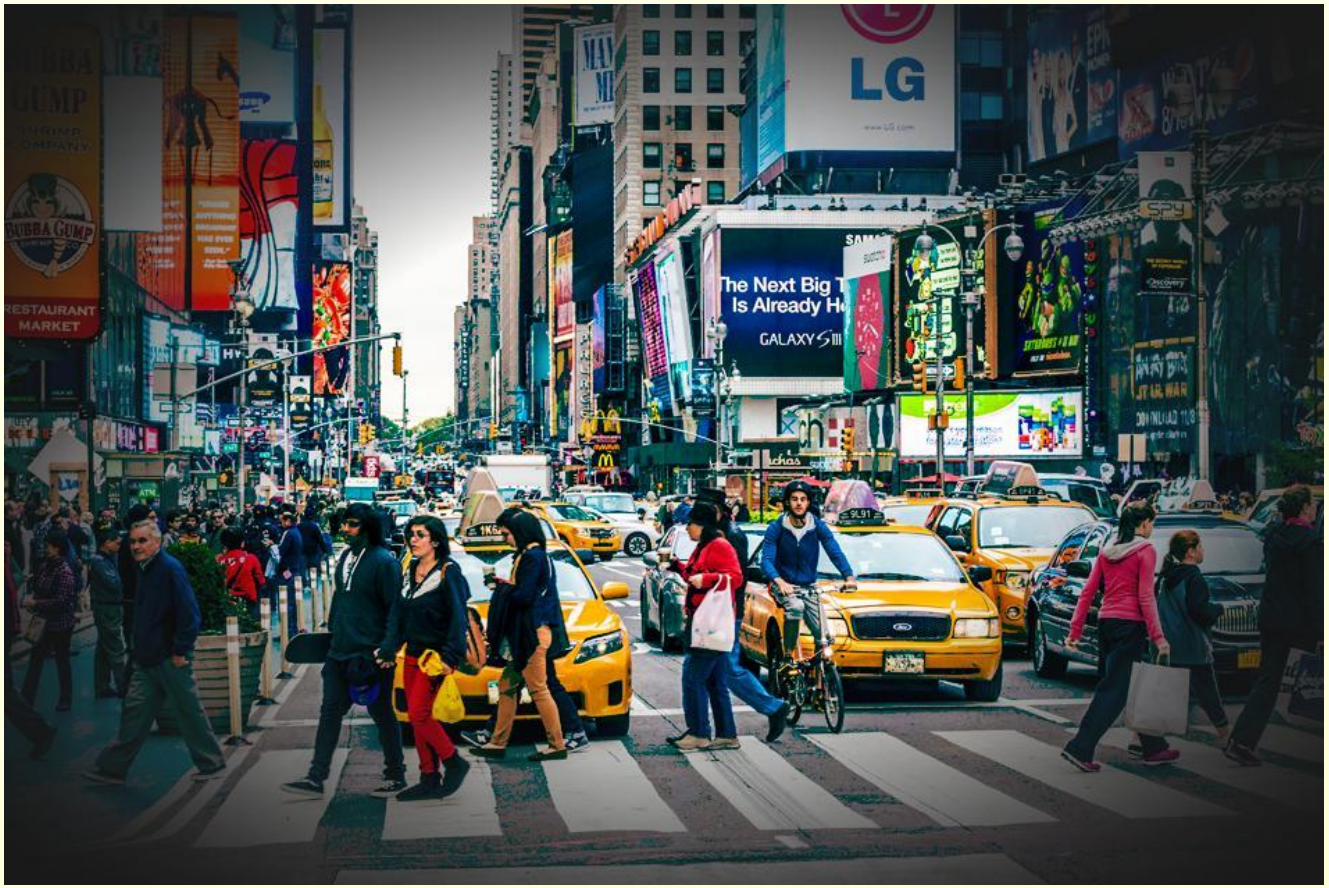
Parallel Image Processing

Lei Cao and Yan Wang

2013-04-19

Image Size: 4753 * 3168 (*3 RGB)

LOMO effect: boundaries are made darker; add contrast to the red channel.




BUBBA GUMP
SHRIMP COMPANY
BUBBA GUMP
RESTAURANT
MARKET
LG
GALAXY S II

Tilt-shift effect: certain regions are made out-of-focus by Gaussian filtering

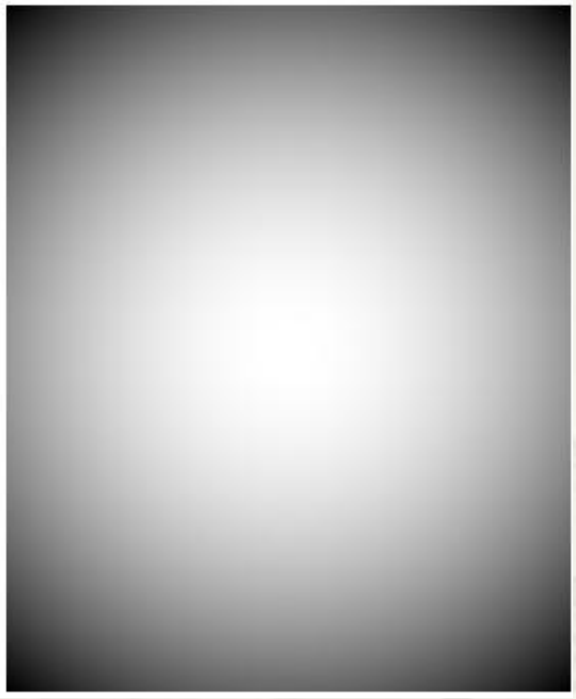
Outline

* Algorithm &Serial Code Profiling
* OpenMP Parallelization
* MPI Parallelization
* Performance
* Future Work

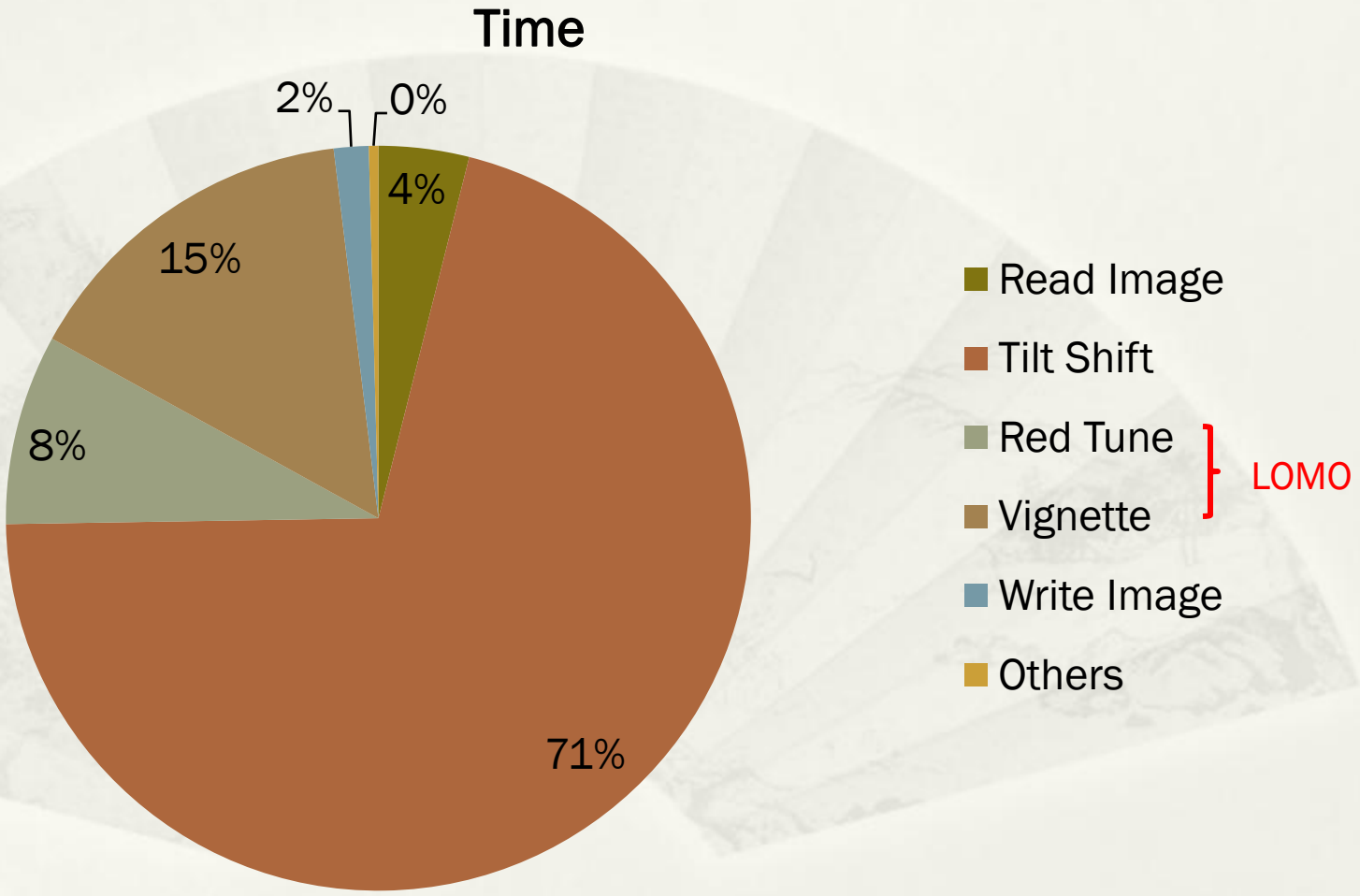
Algorithm

Tilt-shift

LOMO



Serial Program Profiling



Tested at Purdue's Hansen cluster (Dell compute nodes with four 12-core AMD Opteron 6176 processors). Compiler: intel/12.0.084. R&W the image with the JPEG library

	255	135	2								
	221	127	18								
	94	100	33								

4753 * 3168 (*3 RGB)

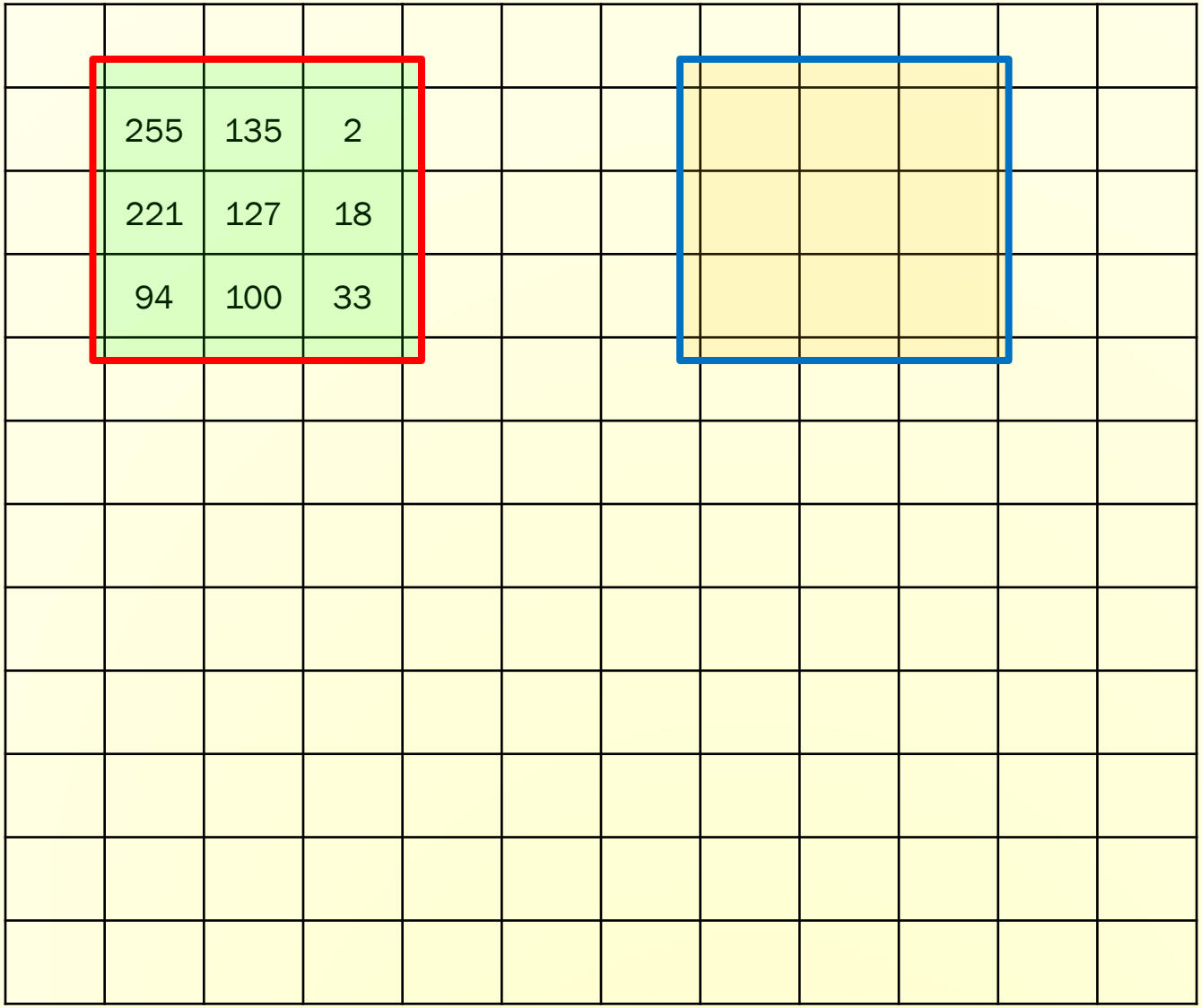
Gaussian Filter:

a1	a2	a3
a4	a5	a6
a7	a8	a9

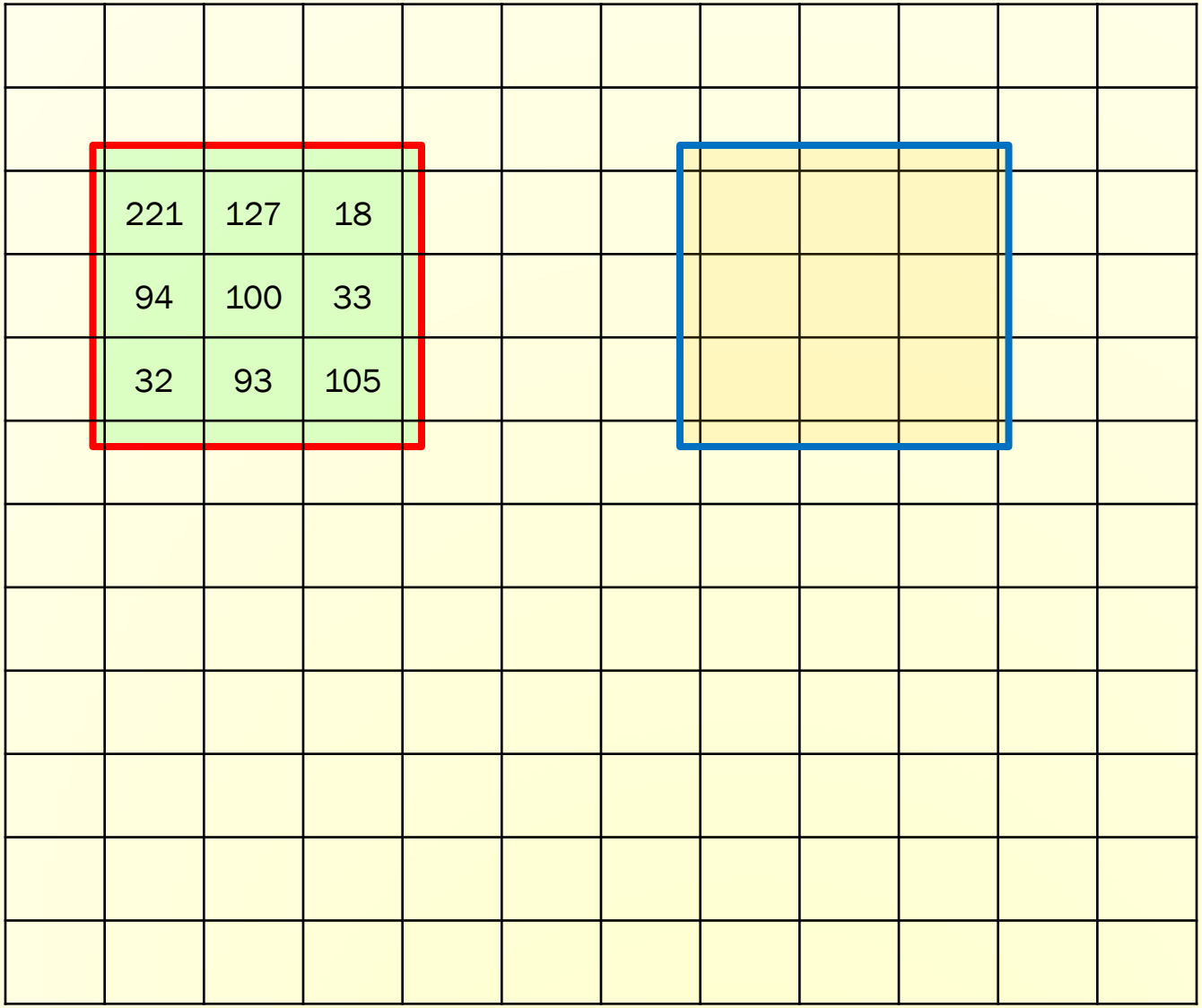
Gaussian Filtering:

Center Weighted Average

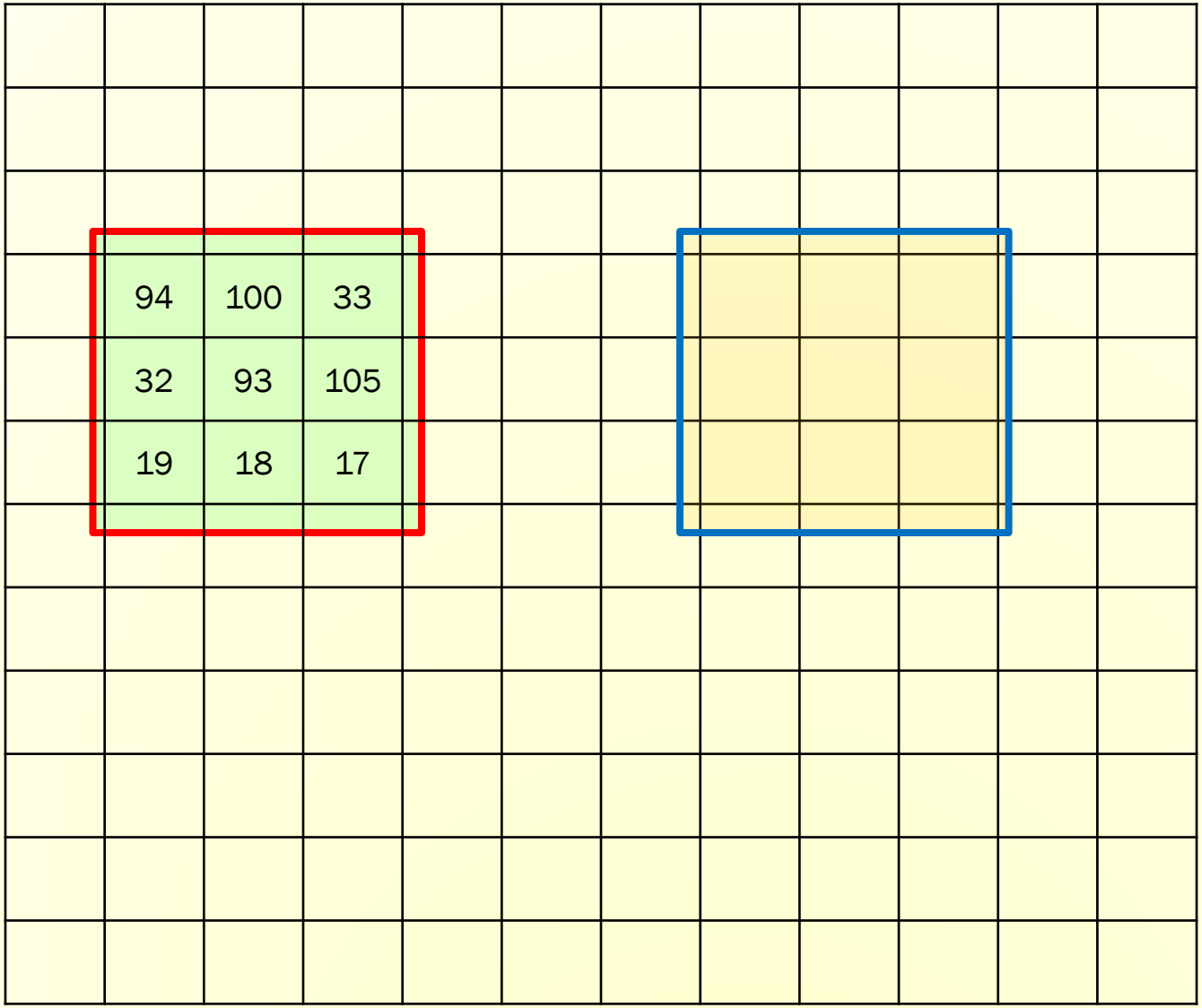
$$p(center) = \frac{\sum p(i) * a(i)}{\sum a(i)}$$



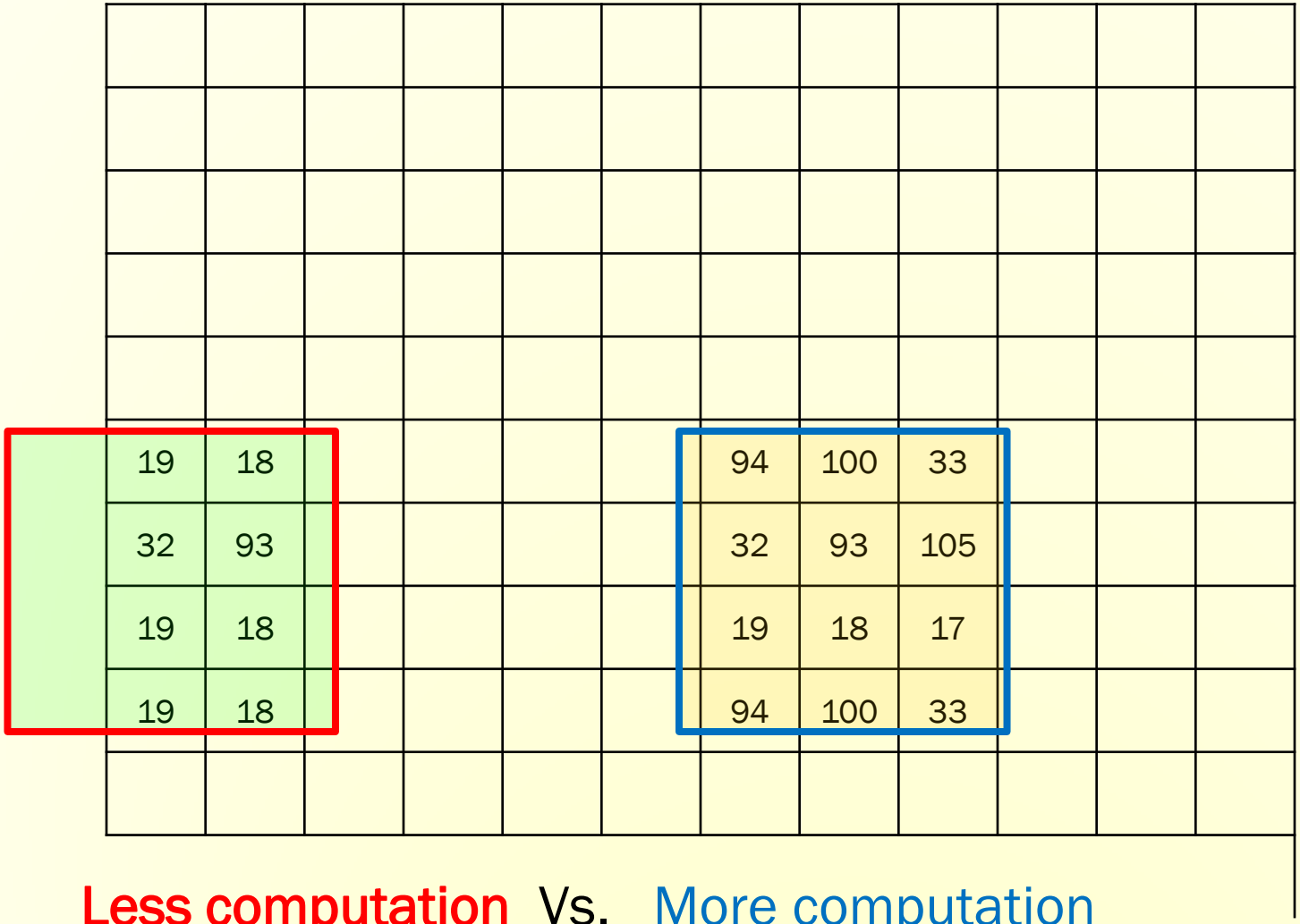
a1	a2	a3
a4	a5	a6
a7	a8	a9



a1	a2	a3
a4	a5	a6
a7	a8	a9



a1	a2	a3
a4	a5	a6
a7	a8	a9



a1	a2	a3
a4	a5	a6
a7	a8	a9

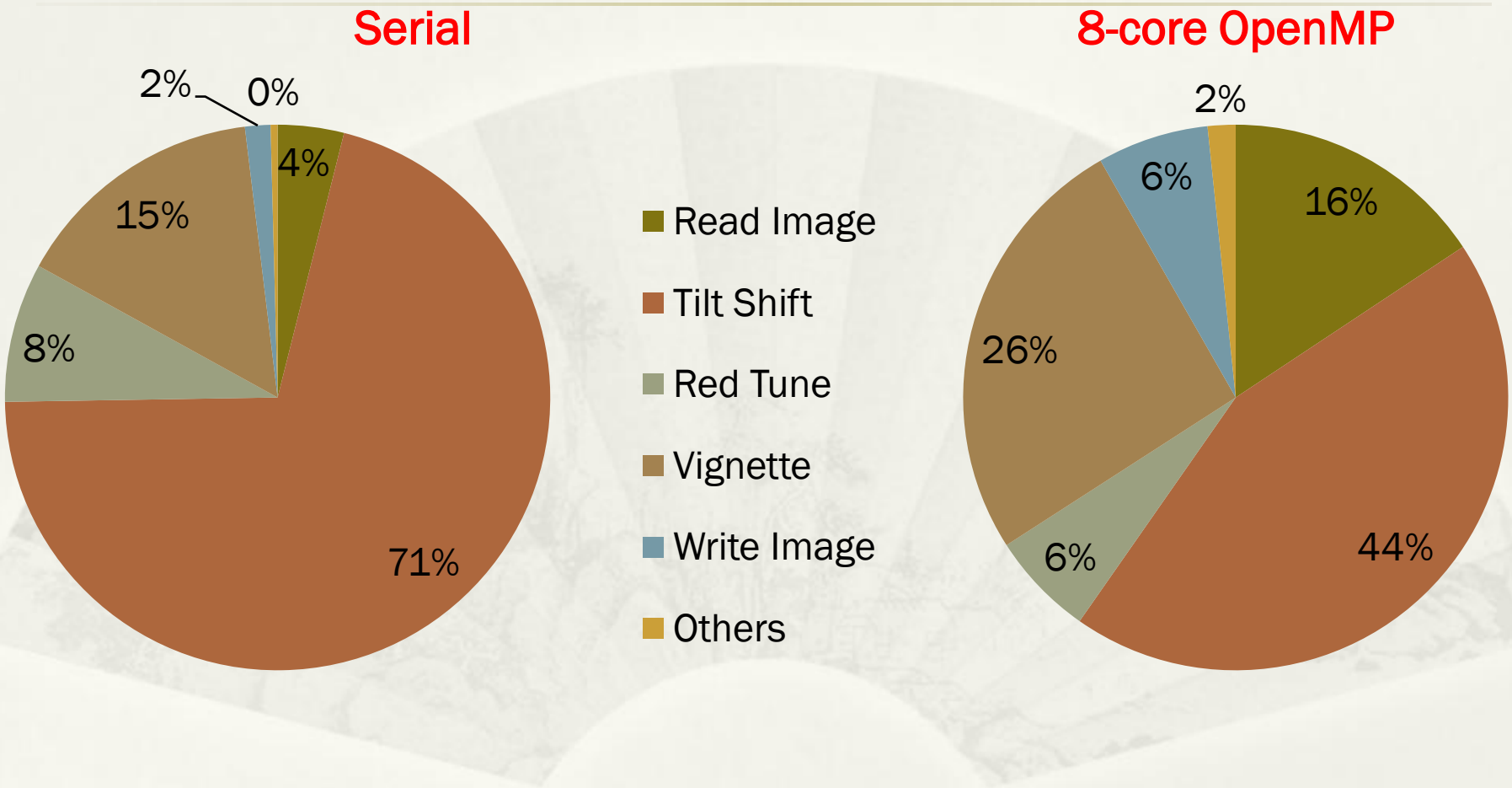
Less computation Vs. More computation

Load Imbalance: dynamical scheduling in OpenMP

OMP Parallelization

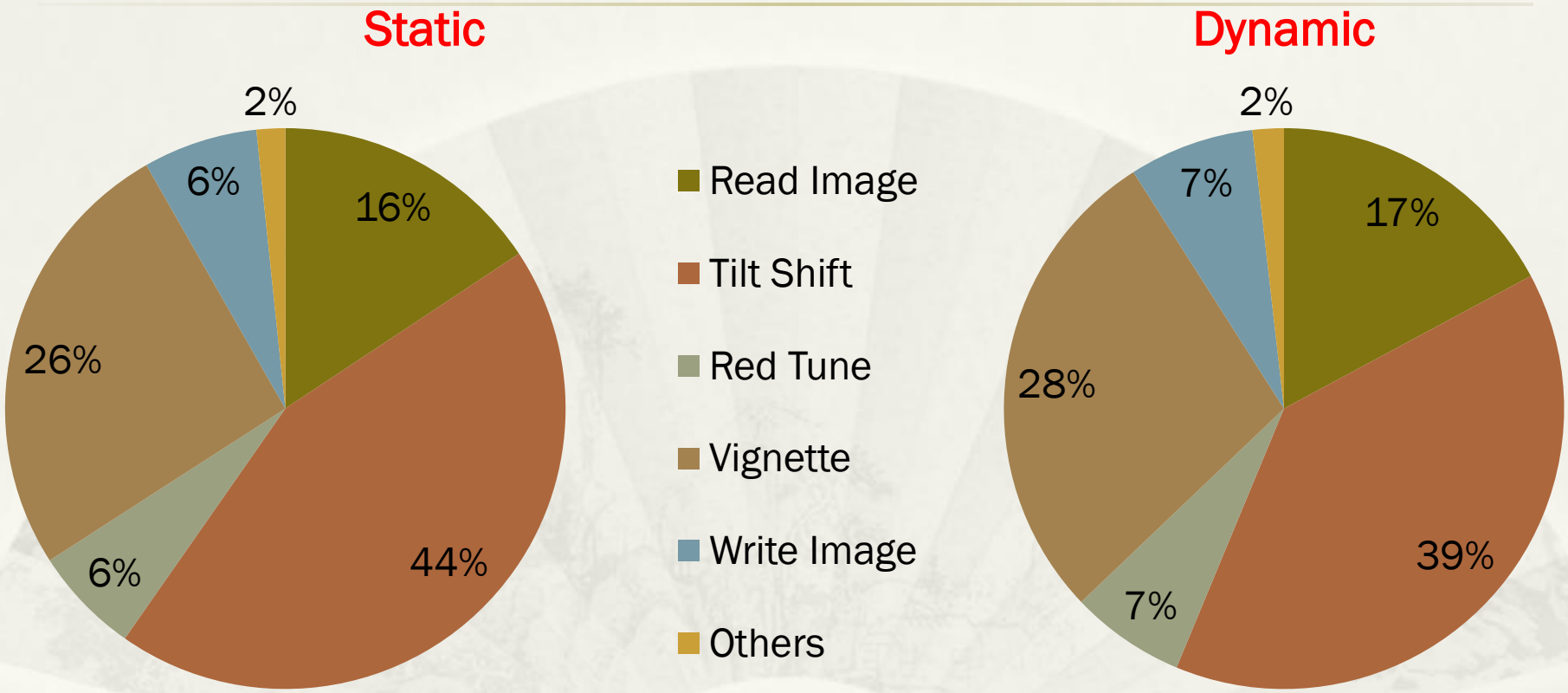
- Dynamics scheduling
- nowait
- Loop coalescing: transform 2D image matrix to 1D array

Performance



Hansen cluster (Dell compute nodes with four 12-core AMD Opteron 6176 processors);
Serial compiler: intel/12.0.084
Parallel compiler: openmpi/1.4.4_intel-12.0.084; 8 cores are used.

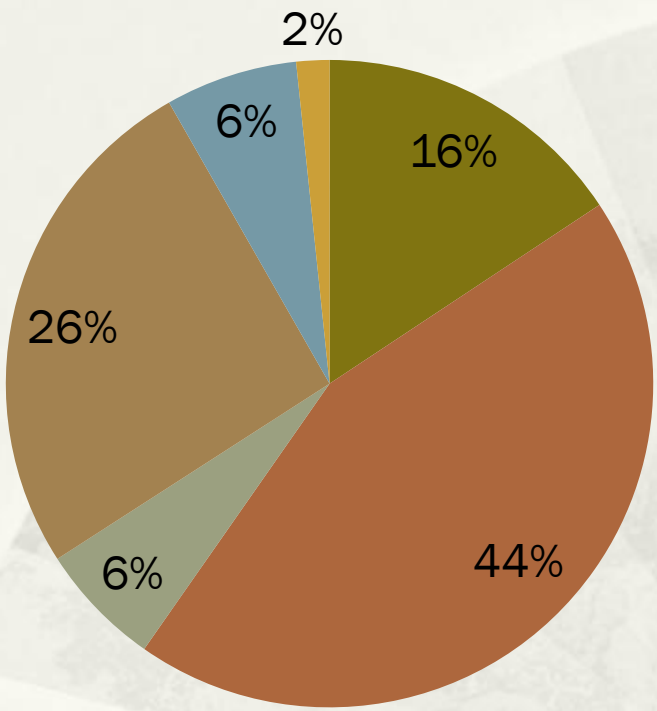
Dynamic Scheduling



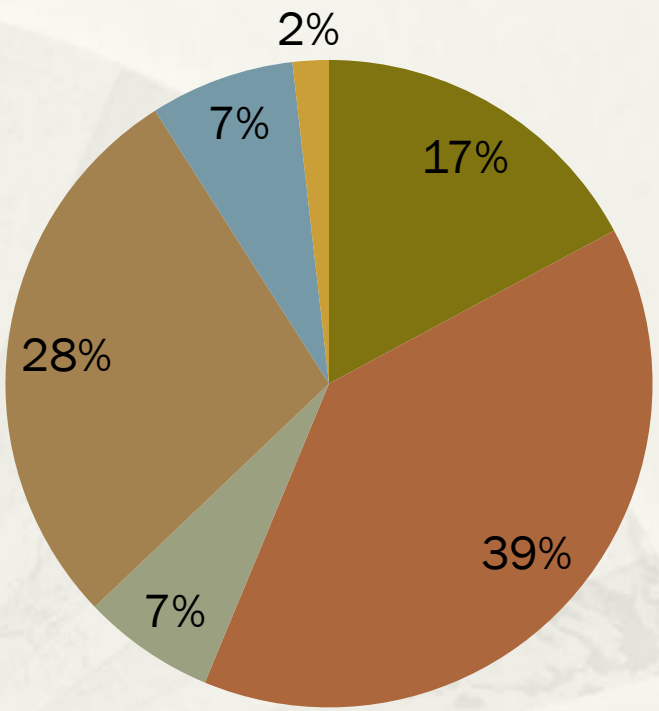
Hansen cluster (Dell compute nodes with four 12-core AMD Opteron 6176 processors);
Serial compiler: intel/12.0.084
Parallel compiler: openmpi/1.4.4_intel-12.0.084; 8 cores are used.

nowait

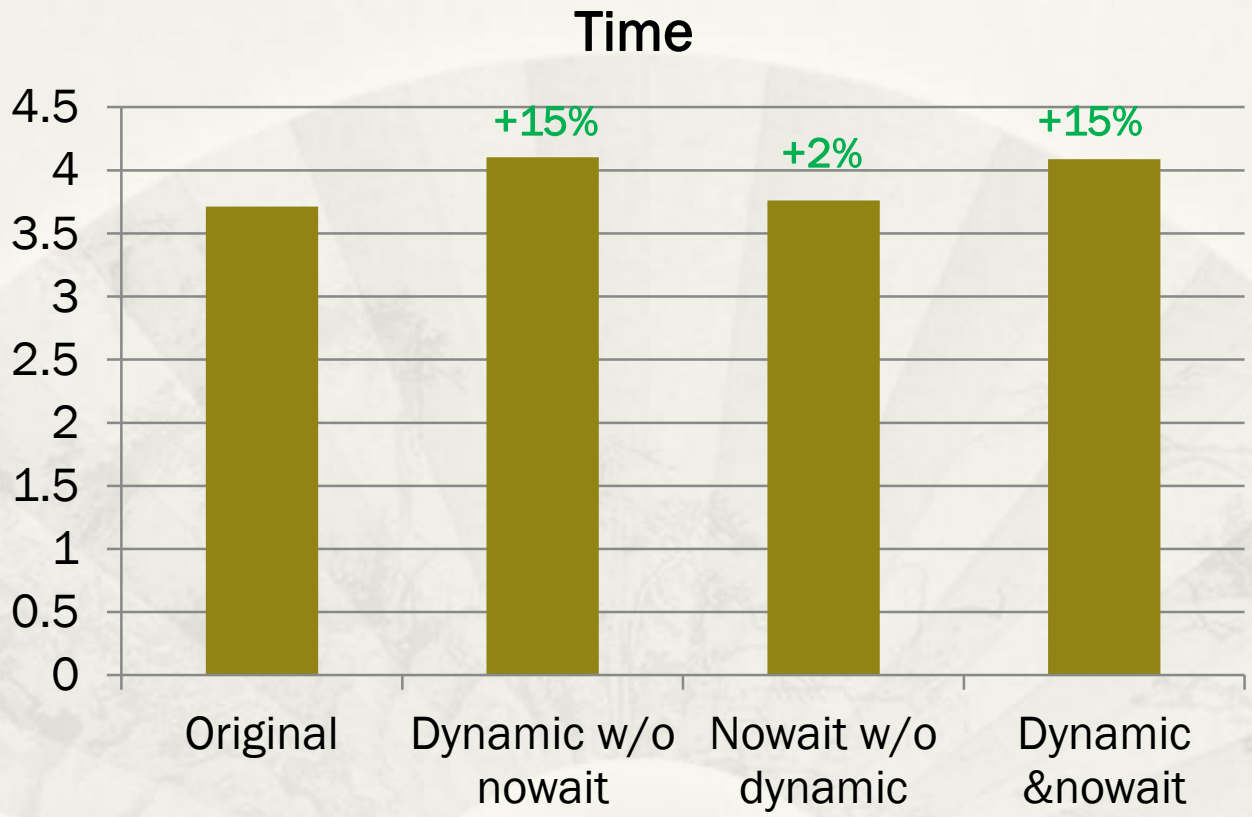
w/o nowait



w/ nowait

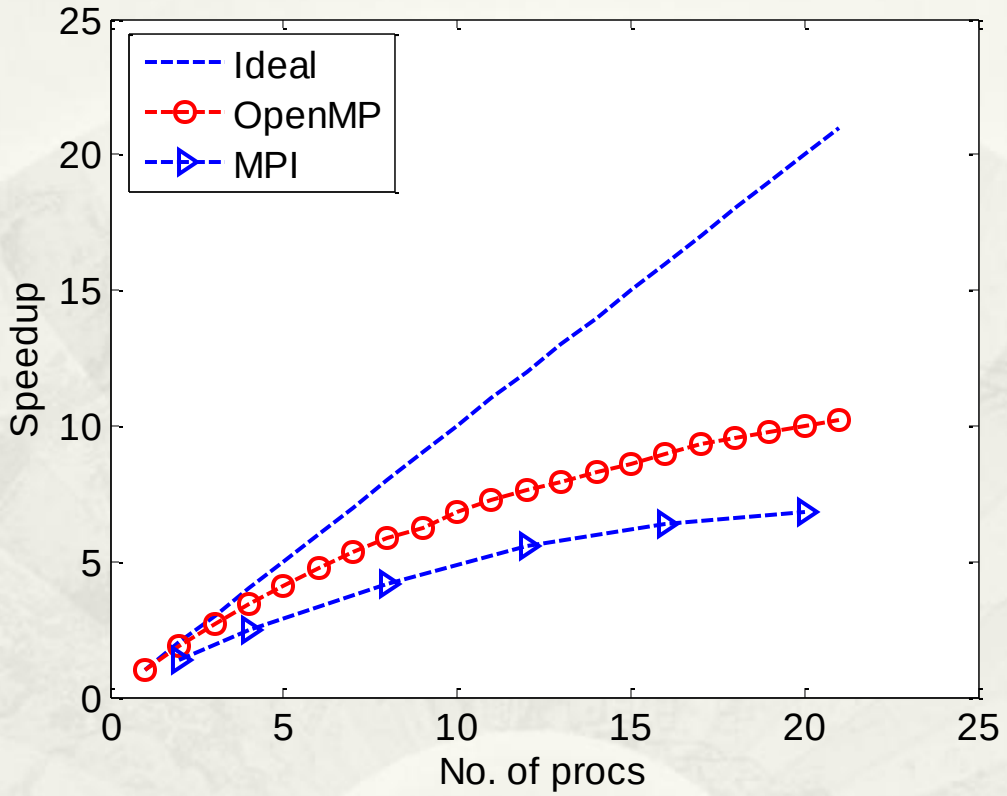


Speedup



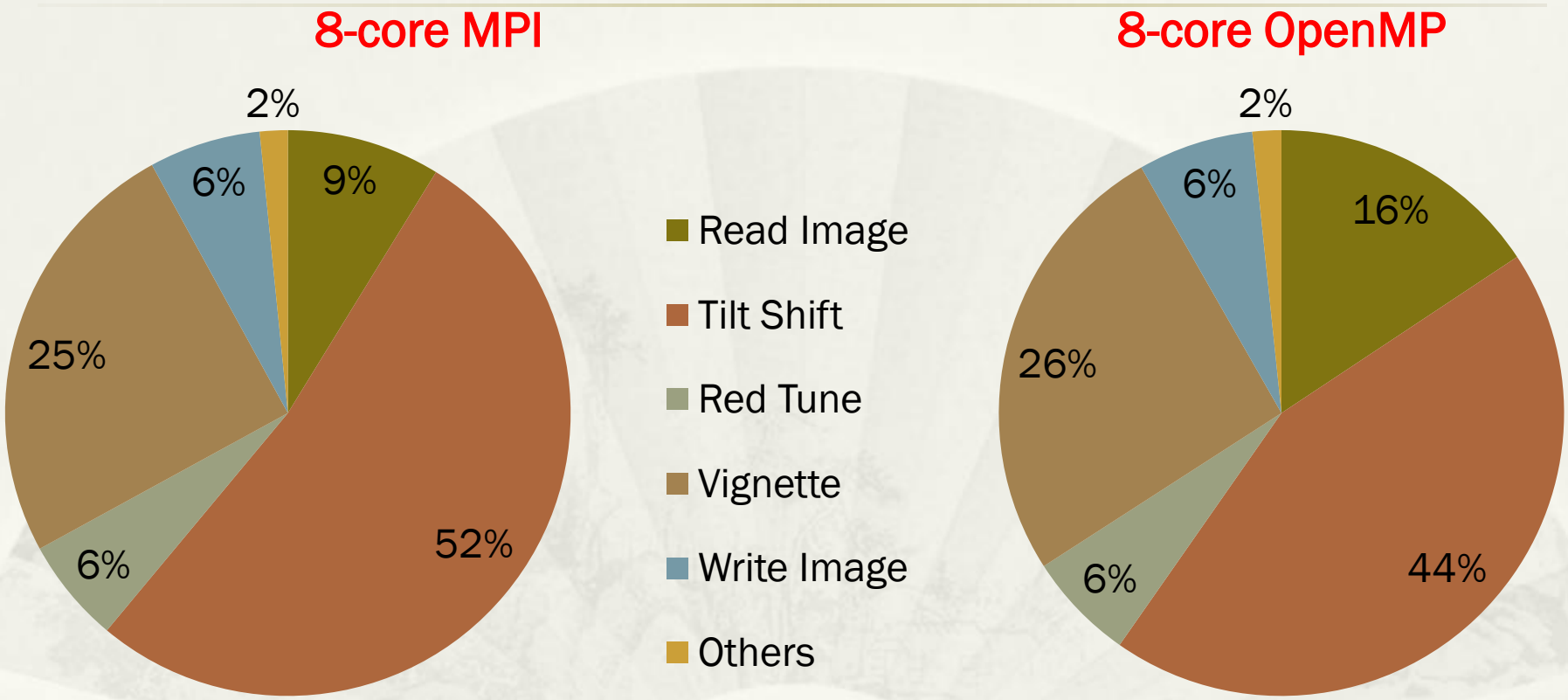
Hansen cluster (Dell compute nodes with four 12-core AMD Opteron 6176 processors); Parallel compiler: openmpi/1.4.4_intel-12.0.084; 8 cores are used.

Speedup of OpenMP and MPI



Hansen cluster (Dell compute nodes with four 12-core AMD Opteron 6176 processors);
OMP compiler: openmpi/1.4.4_intel-12.0.084;
MPI compiler: mpich2-intel/1.4.4_intel-12.0.084

MPI Vs. OpenMP



MPI: creates a large array in each thread, which is inefficient.

Hansen cluster (Dell compute nodes with four 12-core AMD Opteron 6176 processors); Serial compiler: intel/12.0.084; OpenMP compiler: openmpi/1.4.4_intel-12.0.084; MPI compiler: mpich2/1.4.4_intel-12.0.0848

Future Work

- Other image sizes (smaller or larger)
- Find other aspects to improve the speedup
- Try different chunk size in dynamic scheduling

Thanks!