

MONT-BLANC

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Use-case: CFD software with FEM and unstructured meshes

Q. V. Dinh & M. Ravachol

Engineering / R& D and Future Business

Dassault Aviation

EUG meeting, Barcelona, Dec. 11th, 2015



- AeTHER, in-house CFD software
 - Large and old (1985) industrial software
 - Legacy:
 - 500 subroutines & functions, 130,000 lines of Fortran (mostly F77)
 - FEM formulation & discretization using unstructured meshes
 - Communication-bound: lots of indirection...
 - Parallel implementation
 - MPI + local vectorization using coloring techniques
 - Portage on ARM architecture: premature and time-consuming
- Port MiniFEM-asm, a representative mini-application
 - Standard FEM assembling phase,
 - Using the same unstructured meshes as AeTHER
 - Developed for migrating:
 - MPI bulk synchronous => MPI + local task-based parallelism

- **miniFEM-asm**
- Which problem is the application trying to solve?
 - A “surrogate” for industrial CFD code AeTHER, which mimics:
 - FEM assembling phase on representative unstructured meshes
- Programming languages
 - C, C++, Fortran 77 and 95.
 - < 3000 lines of code
- Parallel programming models
 - MPI + task-based parallelism using Divide & Conquer (D&C)
 - For tasks: Intel Cilk++ , OpenMP (OmpSS ?)
- Accelerator programming model: none
- Libraries
 - For D&C : DC_lib (open-source, DA & UVSQ), METIS

- Memory requirement per node (GB)
- Storage required
 - Shared storage
 - Private / temporary storage
- Minimum number of nodes / CPU
- **Not relevant yet on Mont-Blanc ARM platform, however...**
 - Crude evaluation of memory reqs. on Xeon Phi
 - 1 x 60-cores KNC : 1 Million nodes mesh
 - 4 x 60-core KNC : 7 Million nodes mesh

- Not relevant yet on Mont-Blanc ARM platform

- Not relevant yet

Comparison to other platforms (1/2)

- Compare performance (and energy consumption ?) to other platforms : **results available on Xeon Phi**

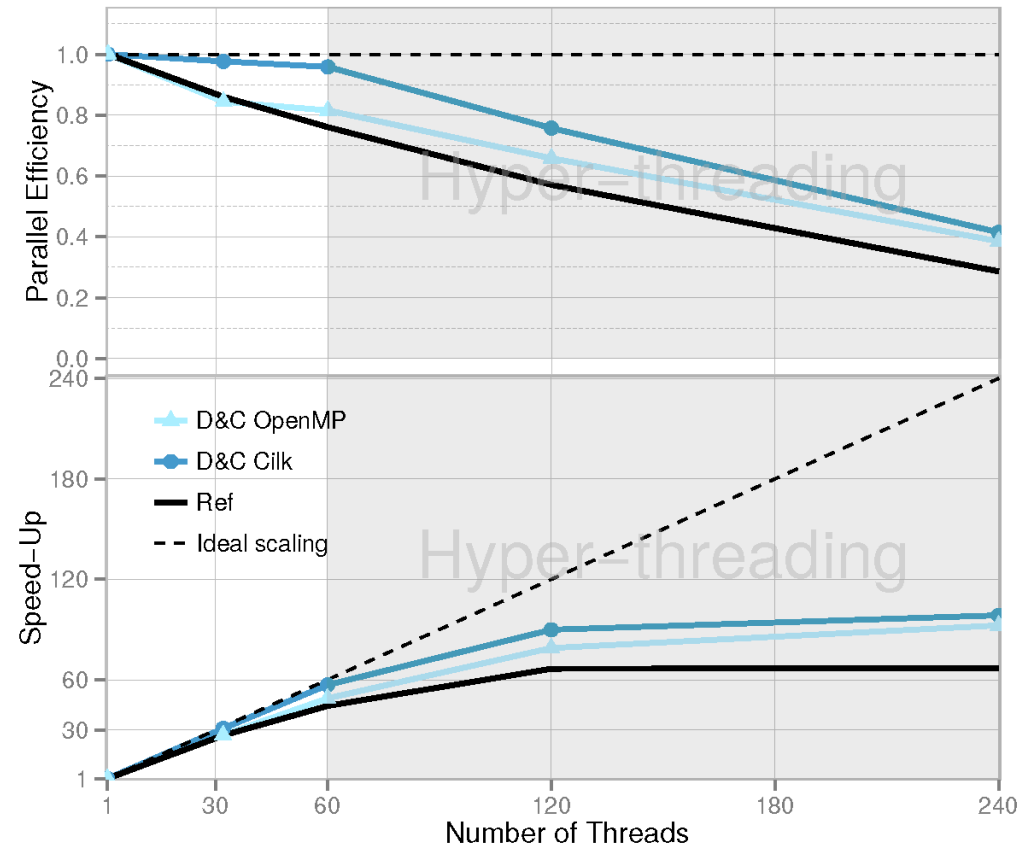
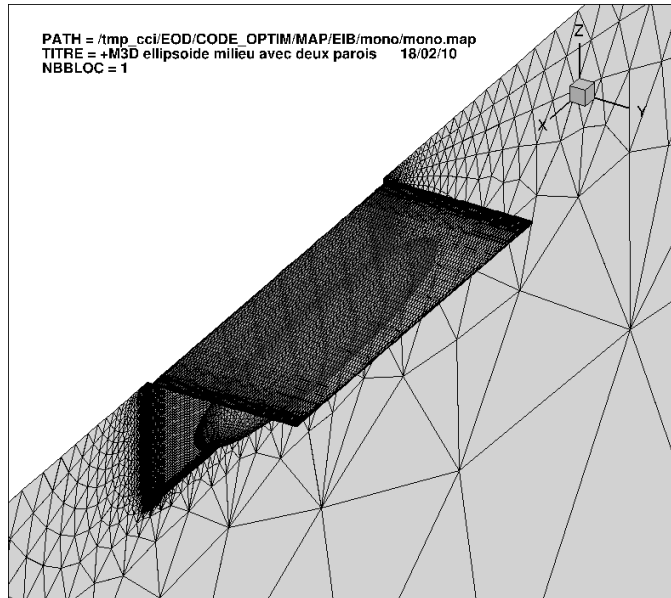
EIB 1 Million-node mesh on 1 KNC

D&C > Ref (pure MPI)

D&C implementations

Cilk > OpenMP

Cilk: **95% efficiency @ 60 cores**



Comparison to other platforms (2/2)

FGN1 7 Million-node mesh on 4 KNCs

D&C > Ref (pure MPI)

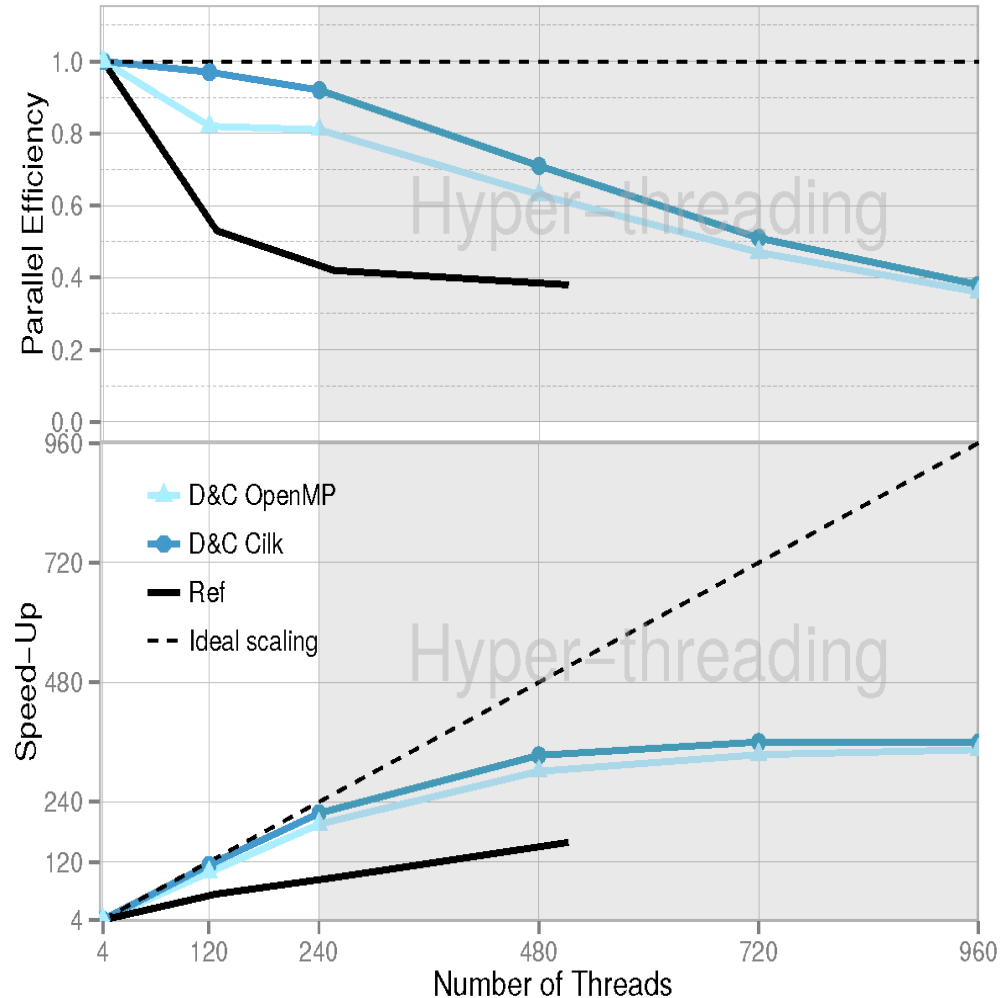
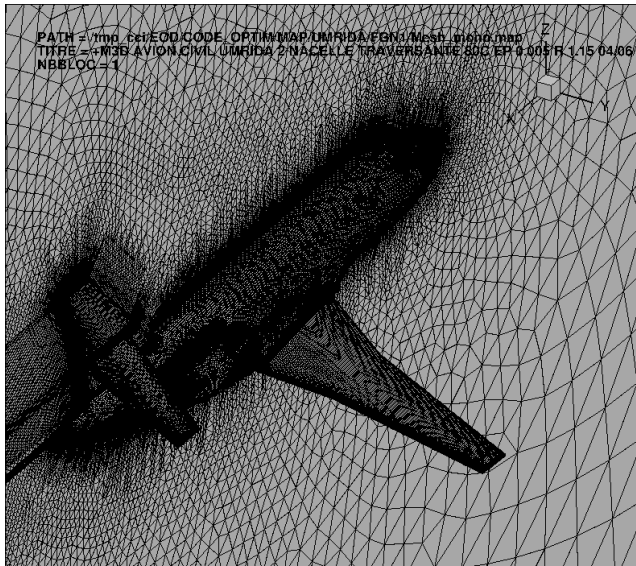
MPI slowed down by PCIe link

D&C implementations

Cilk > OpenMP

Hyperthreading helps off-set OpenMP overhead

Cilk: **90% efficiency @ 60 cores**



- Not relevant yet