Intel® Tools

Intel® Tools

Tools	
Compilers	Intel® C++ Composer XE (icc , icpc) (With its own OpenMP library)
	Intel® Fortran Composer XE
Performance Libraries	Intel® Math Kernel Library (MKL) (Mathematic Operations)
	Intel® Threading Building Blocks (Intel® TBB)
	Intel® Integrated Performance Primitive (Intel® IPP)
	Intel® MPI (can specify which compiler to use)
	Intel® Cilk Plus
	Intel® SDK for OpenCL* Applications XE
Debugger	GDB enhanced with Intel® features (gdb-ia, gdb-mic)
Profiling	Intel® Advisor XE (Threading Advisor)
	Intel® Inspector XE (Memory and threading Debugger)
	Intel® VTune™ Amplifier XE (Performance Analzer)
	Intel® Trace Collector and Analyzer (Graphical tool for MPI calls)

Intel® Parallel Studio XE (cont..)

Cluster edition	• Intel® MPI Library • Intel® Trace Analyzer and Collector
Professional Edition	• Intel® Advisor XE • Intel® Inspector XE • Intel® Vtune Amplifier XE
Composer Edition	• C/C++ Compiler • Fortran Compiler • Intel® MKL Math library • Intel® TBB Threading Library • Intel® IPP media and data library

Intel® Parallel Studio XE

- Intel Parallel Studio is a software development suite for parallel programming.

- suite is a C/C++ and Fortran tool suite supports Linux and Windows OS.

- It is helpful in development, debugging and tuning of code to utilize parallel processing capabilities of compatible Intel processors and coprocessors.

- Currently Parallel Studio is provided in variants

  - **Composer Edition:** includes compilers, performance libraries, and parallel models optimized to build fast parallel code.

  - **Professional Edition:** includes everything in the **Composer edition.** It adds performance profiler, threading design/prototyping, and memory & thread debugger to design, build, debug and tune fast parallel code.

  - **Cluster Edition:** includes everything in the **Professional edition.** It adds a MPI cluster communications library, along with MPI error checking and tuning to design, build, debug and tune fast parallel code

Components of Parallel Studio XE

- Compilers
  - C++ and Fortran Compiler for Linux and Windows OS (MIC also supported)
- Performance Libraries
  - MKL (Math Kernel Library) adds the boost with math routines for applications that solve large computational problems.

  - TBB (Thread Building Blocks) Library that supports scalable parallel programming using standard ISO C++ code.

  - IPP (Integrated Performance Primitives) is an extensive library of software functions to help you develop multimedia, data processing, and communications applications.

  - Cilk Plus is an extension to the C and C++ languages to support data and task parallelism.

Components of Parallel Studio XE (Cont..)

- Advisor XE Is a thread prototyping tool for C, C++ and Fortran programs.

- Inspector XE memory and threading error debugger.

- Vtune Amplifier XE Performance profiling tool to understand CPU utilization with less over head

- Trace Analyzer and Collector graphical tool to visualize MPI application behaviour
   to identify bottlenecks.

Intel ® Inspector XE

* Intel® Inspector XE helps developer resolve Memory and Threading Issues in C/C++ and Fortran applications.

* The tool can be used for static and dynamic error checking in multithreaded application across multiple platforms (Linux and Windows OS).

* The tool can visualize and manage static analysis results provided by the Intel® Compilers and it can also isolate memory error and multi-threading issues.

Intel® Inspector XE Features

* Interactive debugging through well designed GUI and the tool can be invoked as standalone GUI as well as Command line interface.

* Memory growth measurement to help to ensure that the application uses no more memory than expected.

* Data race conditions, deadlock issues, lock hierarchy violations and cross-thread stack access error detection, including error detection on the stack.

* Problem suppressions support to help developer focus on only those issues that requires attention.

Basic Workflow
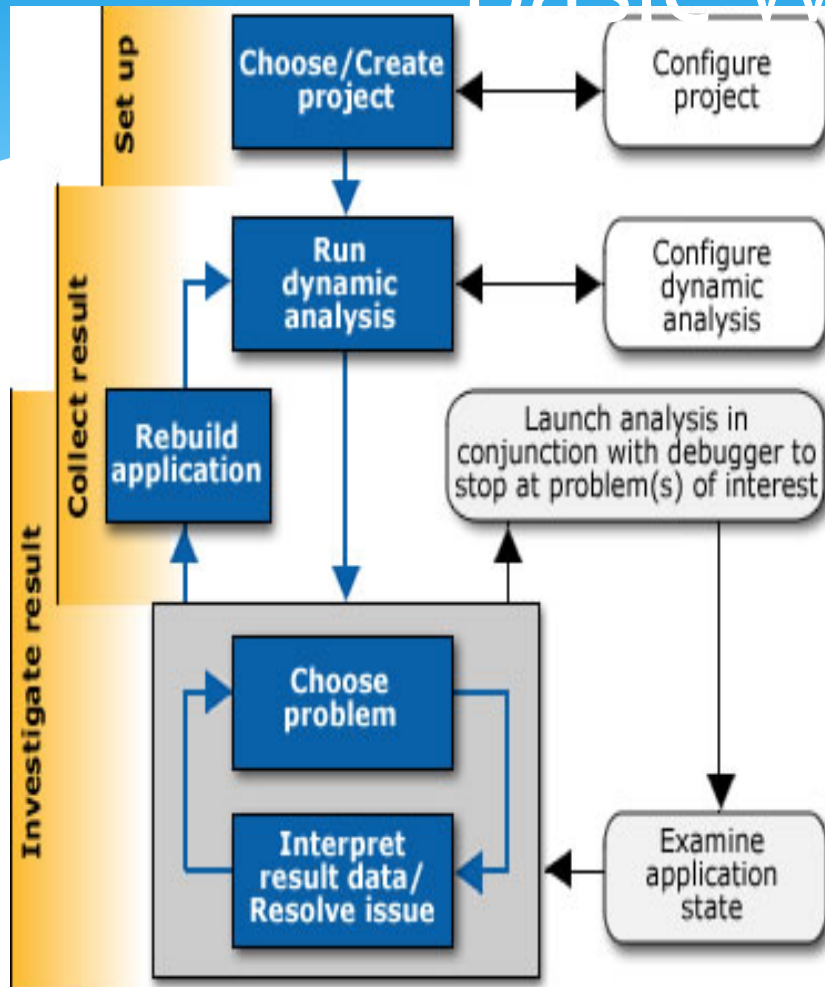
- Create a Intel® Inspector XE project.

- Run Dynamic analysis.

- Run Trip Count analysis.

- Choose problem and Interpret result data and resolve issue.

- Re-build the application and Run dynamic analysis and Go to Step 4.

- Examine the correctness of the application after resolving the issue.

Basic Screen layout

List of Deadlocks and Race conditions
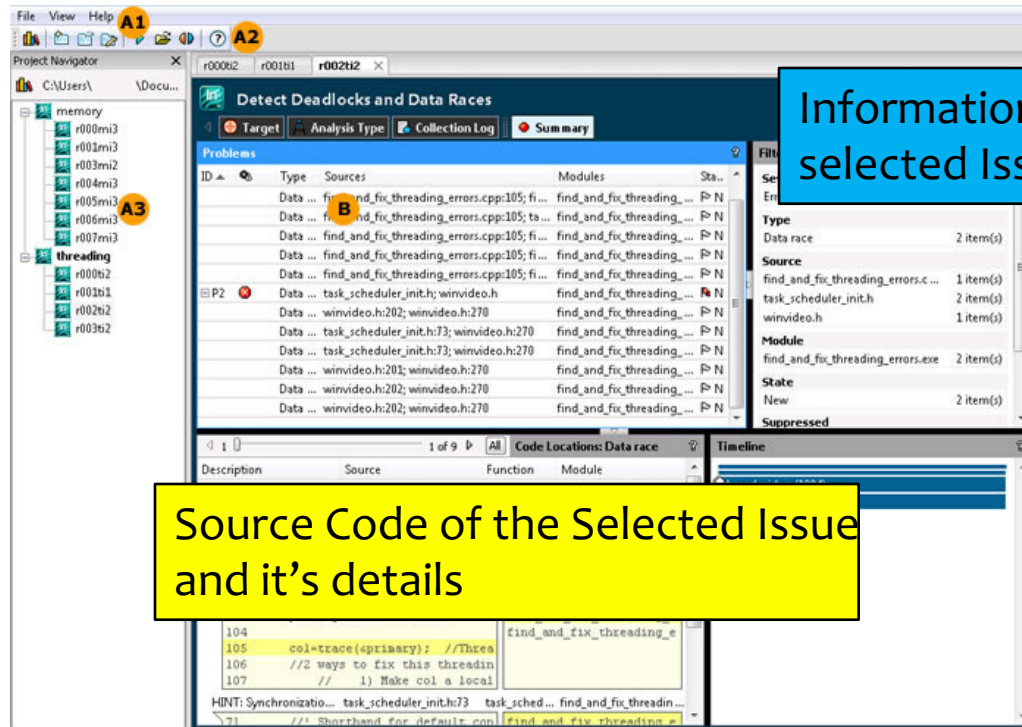
Information on selected Issue

Source Code of the Selected Issue and it's details

Intel® Cilk Plus

* Intel ® Cilk Plus is simple C/C++ language extensions to express data and task parallelism.

* Intel® Cilk Plus provides a easy way to harness the power of both multicore and vector processing.

* Intel® Cilk Plus language extensions for C and C++ are powerful, yet easy to apply and use in a wide range of applications.

* **Intel® Cilk Plus Keywords:**
  * **cilk_spwan -** Specifies that a function call can execute

Intel® Cilk Plus

* **Cilk Plus Reducers:**
  * Intel® Cilk Plus includes *reducers* to help make parallel programming easier.
  * Traditional parallel programs use locks to protect shared variables, which can be problematic and Use of Incorrect lock can result in deadlocks.
  * Reducers provide a lock-free mechanism that allows parallel code to use private "views" of a variable which are merged at the next sync.
* **Task Parallelism Tools:**
  * The Intel® Cilk Plus SDK contains race detection and scalability analysis tools for Cilk-style parallelized binaries.
* **Array Notations:**

INTEL® CILK™ PLUS

C/C++ compiler extension for simplified parallelism

Try these first

Cilk Keywords

cilk_spawn
cilk_sync
cilk_for

Vectorization

__declspec(vector)
__attribute__((vector))
    uniform
    linear mask
#pragma simd
    reduction(op:var)
vectorlength

Reducers

Lists
    list_append
    list_prepend
Min/Max max
    max_index
    min min_index
Math operators
    add
    mul
Bitwise operators
    and
    or
    xor
String concatenation
    string
    wstring
Files
    ostream

Array Notation

Array sections
Array section operations
Section reductions
    add
    mul
    max
    max_index
    min
    min_index
    all_zero
    all_nonzero
    any_zero
    any_nonzero
    mutating
    user-defined

Tools

Intel® Cilk™ Screen
Intel® Cilk™ View

Intel® MPI Library

Intel® MPI Library is a multi-fabric message passing library that implements the Message Passing Interface, version 3.0 (MPI-3.0) specification.

Intel® MPI Library Benefits:

* Low latency MPI implementation up to 2 times as fast as alternative MPI libraries.

* Enable optimized shared memory dynamic connection mode for large SMP nodes.

Intel® MPI Library

* Intel® MPI Library Features:

  * Scalability up to 262k processes

  * Low overhead, enables analyzing large amounts of data

  * MPI tuning utility for accelerating your applications

  * Interconnect independence and flexible runtime fabric selection

Benchmarks of Intel® Libraries

Superior Performance with Intel® MPI Library 5.1

1792 Processes, 64 nodes (InfiniBand + shared memory), Linux* 64
Relative (Geomean) MPI Latency Benchmarks (Higher is Better)

Up to 5.2X faster on 64 nodes

Chart — Speedup (times):
- 4 bytes: IntelMPI 5.1 = 3.6, MVAPICH2 2.1 ≈ 1.7, OpenMPI 1.8.5 = 1
- 512 bytes: IntelMPI 5.1 = 3.6, MVAPICH2 2.1 ≈ 2.4, OpenMPI 1.8.5 = 1
- 16 Kbytes: IntelMPI 5.1 = 4.3, MVAPICH2 2.1 ≈ 3.1, OpenMPI 1.8.5 = 1
- 128 Kbytes: IntelMPI 5.1 = 5.2, MVAPICH2 2.1 ≈ 3.6, OpenMPI 1.8.5 = 1
- 512 Kbytes: IntelMPI 5.1 = 4.7, MVAPICH2 2.1 ≈ 4.1, OpenMPI 1.8.5 = 1

■ IntelMPI 5.1   ■ MVAPICH2 2.1   ■ OpenMPI 1.8.5

DGEMM

DGEMM Performance Boost by using Intel® MKL vs. ATLAS*
(higher is better)
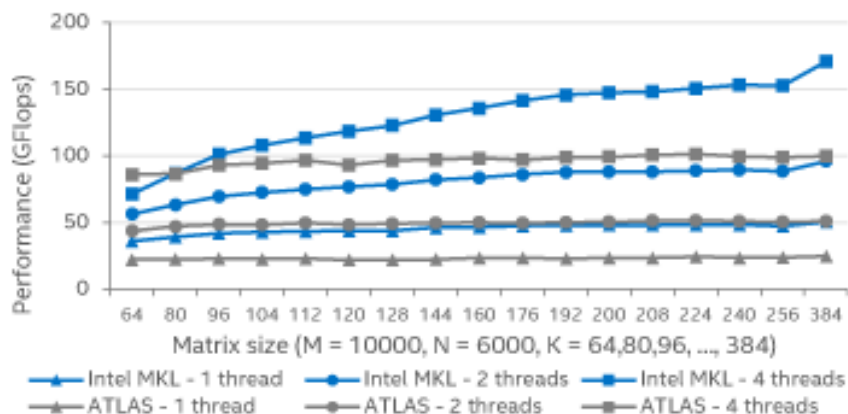
Configuration Info – Versions: Intel® Math Kernel Library (Intel® MKL) 11.3, ATLAS* 3.10.2; Hardware: Intel® Xeon® Processor E5-2699v3, 2 Eighteen-core CPUs (45MB LLC, 2.3GHz), 64GB of RAM; Intel® Core™ Processor i7-4770K, Quad-core CPU (8MB LLC, 3.5GHz), 8GB of RAM; Operating System: RHEL 6.4 GA x86_64.

Software and workloads used in performance tests may have been optimized for performance only on Intel microprocessors. Performance tests, such as SYSmark and MobileMark, are measured using specific computer systems, components, software, operations and functions. Any change to any of those factors may cause the results to vary. You should consult other information and performance tests to assist you in fully evaluating your contemplated purchases, including the performance of that product when combined with other products. *Other brands and names are the property of their respective owners. Benchmark Source: Intel Corporation.

Optimization Notice: Intel's compilers may or may not optimize to the same degree for non-Intel microprocessors for optimizations that are not unique to Intel microprocessors. These optimizations include SSE2, SSE3, and SSSE3 instruction sets and other optimizations. Intel does not guarantee the availability, functionality, or effectiveness of any optimization on microprocessors not manufactured by Intel. Microprocessor-dependent optimizations in this product are intended for use with Intel microprocessors. Certain optimizations not specific to Intel microarchitecture are reserved for Intel microprocessors. Please refer to the applicable product User and Reference Guides for more information regarding the specific instruction sets covered by this notice. Notice revision #20110804 .
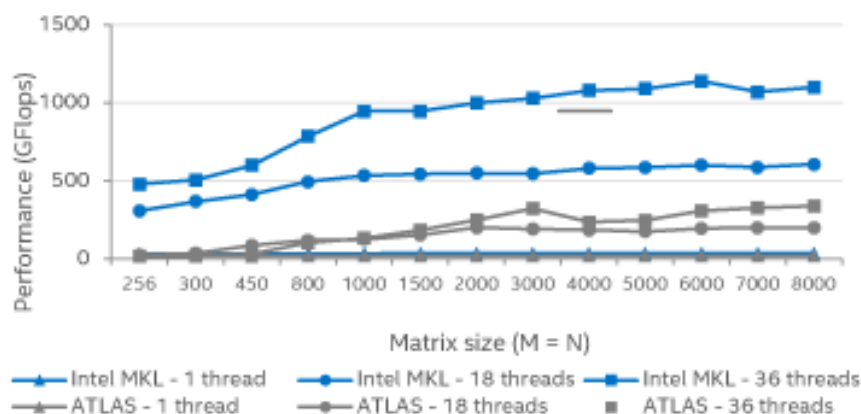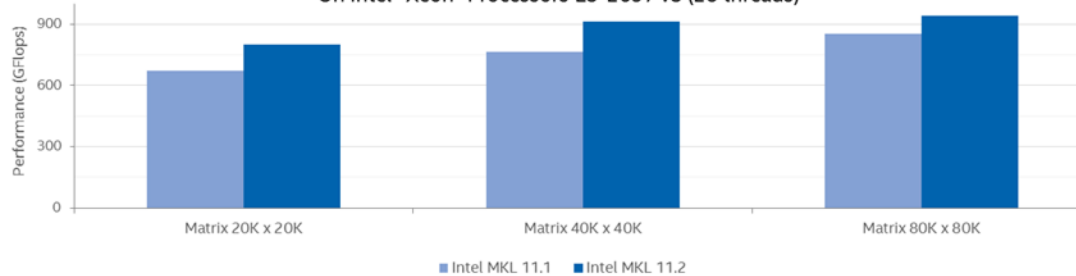
LINPACK

Improved Performance with Intel® Optimized LINPACK
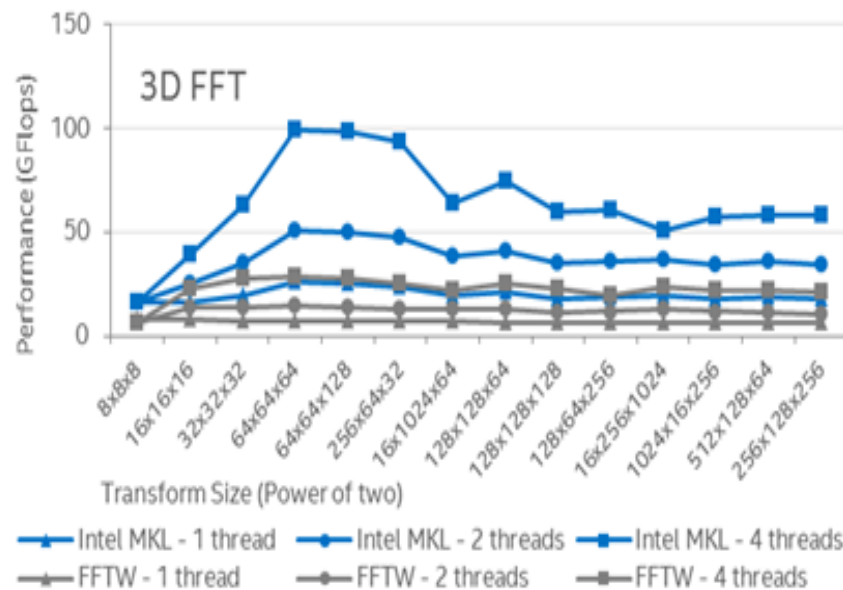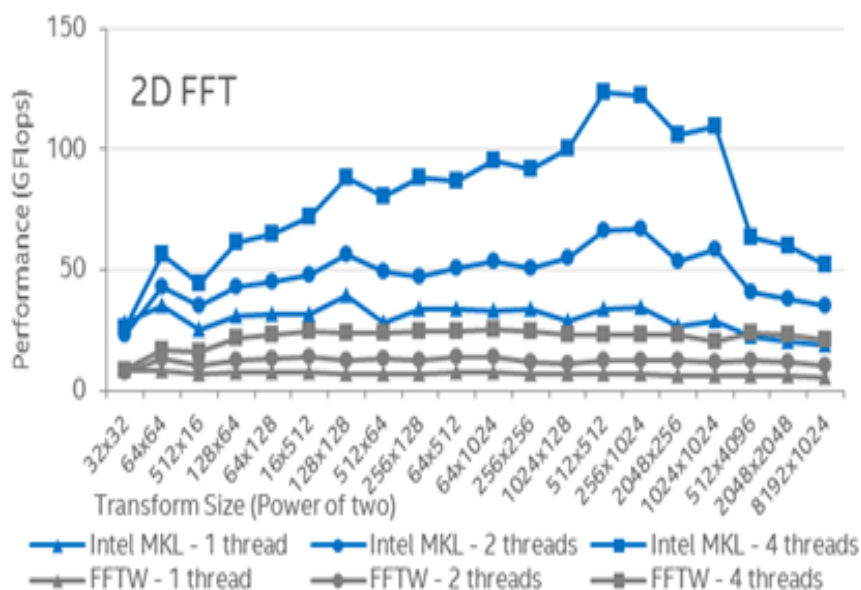On Intel® Xeon® Processors E5-2697 v3 (28 threads)

Configuration Info - Versions: Intel® Math Kernel Library (Intel® MKL) 11.2; Hardware: Intel® Xeon® Processor E5-2699 v3, 2 Fourteen-core CPUs (35MB LLC, 2.6GHz), 64GB of RAM; Operating System: RHEL 6.1 GA x86_64;

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Single Precision Complex 2D & 3D FFT Performance Boost using Intel® MKL vs. FFTW*

Configuration Info - Versions: Intel® Math Kernel Library (Intel® MKL) 11.2, FFTW* 3.3.4; Hardware: Intel® Xeon® Processor E5-2697 v3, 2 Fourteen-core CPUs (35MB LLC, 2.6GHz), 64GB of RAM; Intel® Core™ Processor i7-4770K, Quad-core CPU (8MB LLC, 3.5GHz), 8GB of RAM; Operating System: RHEL 6.1 GA x86_64;

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Compilers

icc/icpc
Intel® C/C++ Compilers

ifort
Intel® Fortran Compiler

Libraries

Intel® Math Kernel Library (Intel® MKL)

Intel® Thread Building Blocks (Intel® TBB)

Intel® Cilk Plus

Intel® OpenMP

Intel® MPI

Profiling Tools

Intel® Advisor XE

Intel® Inspector XE

Intel® Vtune Amplifier

Intel® Trace Analyzer and Collector

Questions