



Intel® Software Development Products for Intel Platforms and Technologies

Intel® Math Kernel Library (Intel® MKL)

Overview

The Intel® Math Kernel Library (Intel® MKL) is composed of highly optimized functions for math, engineering, scientific, and financial applications that require high performance on Intel platforms. The functional areas of the library include linear algebra consisting of LAPACK and BLAS, discrete Fourier Transforms (DFT), vector transcendental functions (vector math library/VML) and vector statistical library (VSL) functions.

What's New in the Intel Math Kernel Library

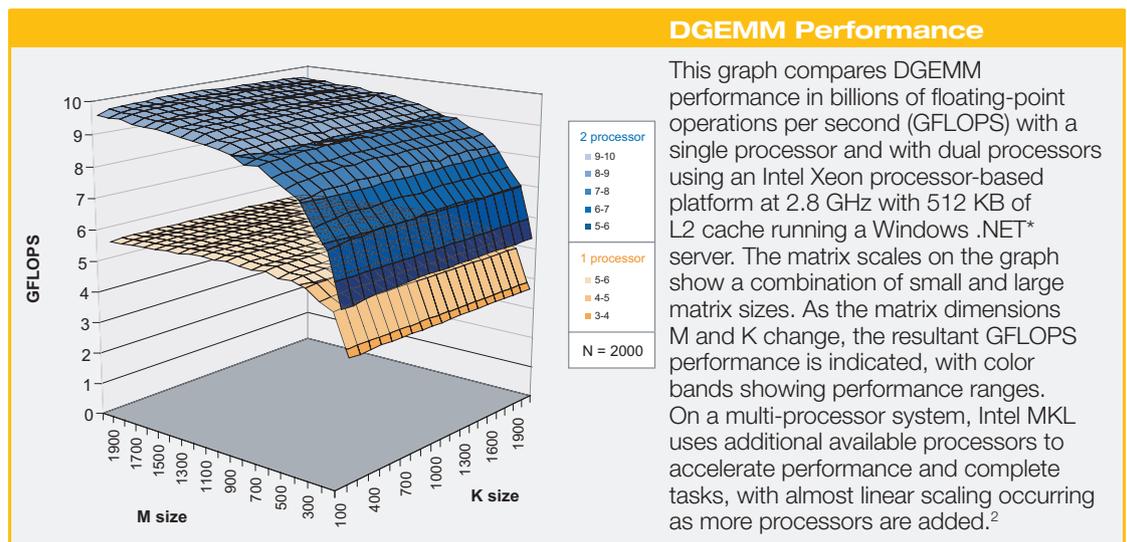
- Intel Math Kernel Library continues to excel by delivering improved performance and additional numerics functionality to meet the demands of today's applications and simulation workloads on Intel processor-based desktops, workstations and servers.
- The DFT extends the FFT coverage of Intel Math Kernel Library, providing one-dimensional and multi-dimensional routines (up to the order of 7) with transform lengths of other than powers of 2 (mixed radix support).
- The vector statistical library offers high-performance random number generators that are hand assembled, tuned, and vectorized. These pseudorandom number-generator subroutines provide both basic continuous and discrete distributions.

Features and Benefits

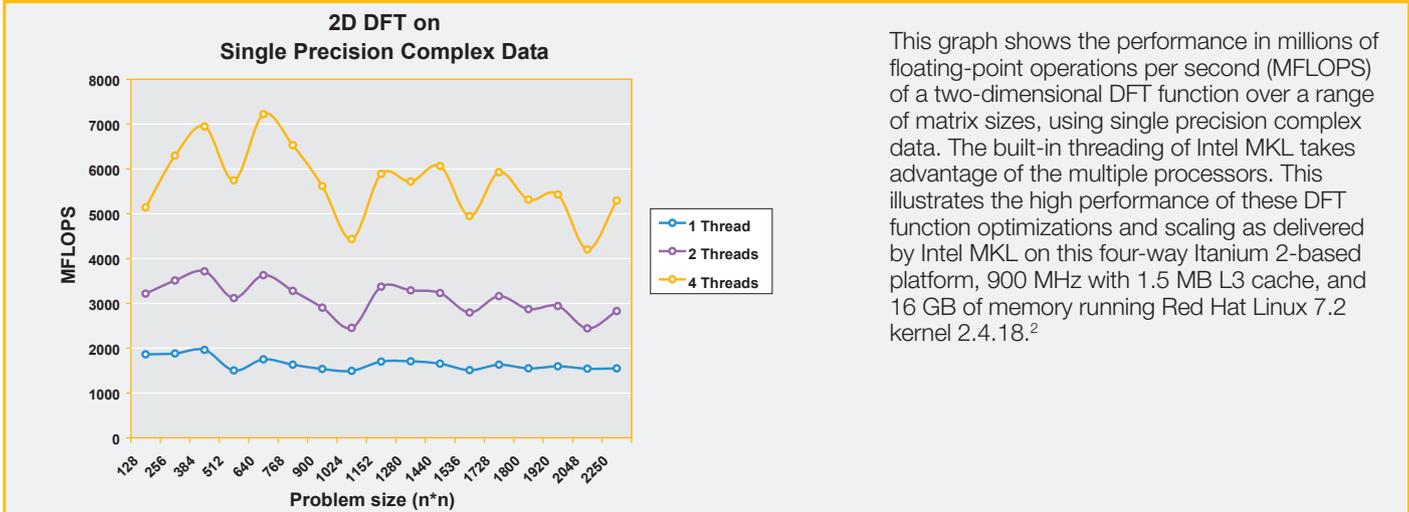
- **High Performance Floating-point Math**
- **Linear algebra** with LAPACK (solvers and eigensolvers) plus BLAS Levels 1, 2, 3 (vector, vector-matrix, matrix-matrix) operations
- **1D, and up to 7D Discrete Fourier Transforms** with complex-to-complex, real-to-complex, complex-to-real and conjugate even types
- **Vector Math Library (VML)** provides a set of highly optimized implementations of certain computationally expensive core mathematical functions, including power, trigonometric, exponential and hyperbolic, providing vector transcendental functions offering speed over scalar versions
- **Vector statistical library (VSL)** offers vectorized random number generators for improved performance
- **Multi-threading support** using OpenMP* plus a fully thread-safe library
- **High performance** on Intel Pentium® 4, Intel® Xeon™, Intel Itanium® 2 processors and Pentium M processor component of Intel® Centrino™ mobile technology¹
- **Trial version** available

Intel Math Kernel Library Features Optimize your Code

- Focus your development time on building value-add features using the highly-optimized library functions of Intel Math Kernel Library, to help you get your optimized applications to market faster.
- Write once to the Intel MKL application programming interface (API) and yield performance benefits across the range of Intel microprocessors, saving you time.
- **Parallelism Built-in** — Many functions in Intel Math Kernel Library are threaded, providing the advantages of parallelism, including excellent scaling for applications with none of the work.



DFT Function Optimizations



This graph shows the performance in millions of floating-point operations per second (MFLOPS) of a two-dimensional DFT function over a range of matrix sizes, using single precision complex data. The built-in threading of Intel MKL takes advantage of the multiple processors. This illustrates the high performance of these DFT function optimizations and scaling as delivered by Intel MKL on this four-way Itanium 2-based platform, 900 MHz with 1.5 MB L3 cache, and 16 GB of memory running Red Hat Linux 7.2 kernel 2.4.18.²

Performance Improvements Linear Algebra and DGEMM

Matrix multiplication is a cubic operation; doubling the sizes of the matrices to be multiplied increases the number of operations by a factor of 8. Double-precision general matrix-matrix multiply (DGEMM) is the workhorse routine for dense linear algebra. In many applications that are heavily dependent on the solution of large systems of equations, the performance of properly-written solvers depends directly on DGEMM performance.

PERFORMANCE

Powerful Computing on Your Desktop

The various functional areas of Intel MKL (LAPACK, BLAS, DFTs, VML and VSL) provide optimized performance for the latest features and capabilities of the Intel® Pentium® 4, Intel® Xeon™, Intel Itanium® 2 processors and Pentium M processor component of Intel® Centrino™ mobile technology¹. Many functions in Intel MKL have been threaded to provide greater performance on symmetric multiprocessing (SMP) systems. This provides the advantages of parallelism, including excellent scaling for applications, with none of the work.

COMPATIBILITY

Applications Optimized for Intel Processor-based Systems

The Intel Math Kernel Library is compatible with Windows and Linux environments, including Windows 2000, Millennium Edition, and XP. Linux support includes Linux distributions with 2.4x kernels or later. Intel MKL runs with Intel Fortran Compiler 6.0 or later, Compaq Visual Fortran* 6.0, Intel C++ Compiler 6.0 or

later, and Microsoft Visual C++* Compiler 6.0 or later. Whether you program in Fortran or C, on Windows or Linux, Intel MKL optimizes the performance. Both Fortran and C interfaces exist for the basic linear algebra subroutines (BLAS); the C interface for the BLAS is also referred to as CBLAS. The LAPACK functions are available with a Fortran interface. Fortran and C interfaces are available for all of the Discrete Fourier Transform functions, the vector math library (VML) functions and the vector statistical library (VSL) functions.

SUPPORT

Intel® Premier Support

Every purchase of an Intel® Software Development Product includes a year of support services, which provides access to Intel® Premier Support and all product updates during that time. Intel Premier Support gives you online access to technical notes, application notes, and documentation. Install the product, and then register to get support and product update information.

REQUIREMENTS

Hardware and Software

Refer to Intel® Software Development Products Web site for details on system requirements for Intel Math Kernel Library at www.intel.com/software/products/mkl

¹ Wireless connectivity requires additional software, services or external hardware that may need to be purchased separately. Availability of public wireless access points is limited. System performance, battery life and functionality will vary depending on your specific hardware and software.

² Performance tests and ratings are measured using specific computer systems and/or components and reflect the approximate performance of Intel Products as measured by those tests. Any difference in system hardware or software design or configuration may affect actual performance. Buyers should consult other sources of information to evaluate the performance of systems or components they are considering purchasing. For more information on performance tests and on the performance of Intel products go to www.intel.com/software/products

Intel provides both the tools and support to enhance the performance, functionality and efficiency of software applications.

Compatible with leading Windows* and Linux* development environments, Intel® Software Development Products are the fastest and easiest way to take advantage of the latest features of Intel processors. Intel Software Development Products are designed for use in the full development cycle, and include Intel® Performance Libraries, Intel Compilers (C++, Fortran for Windows and Linux), Intel® VTune™ analyzers, Intel® Threading Tools and Intel® Cluster Tools.

The Intel® Premier Customer Support Web site provides expert technical support for all Intel software products, product updates and related downloads.

For additional product information visit: www.intel.com/software/products



Intel, the Intel logo, Itanium, Pentium, Intel Centrino, Intel Xeon, Intel XScale, VTune, Celeron, Intel NetBurst, and MMX are trademarks or registered trademarks of Intel Corporation or its subsidiaries in the United States and other countries.

*Other brands and names may be claimed as the property of others.

Copyright © 2004, Intel Corporation. All rights reserved. 0104/JXP/ITF/PDF

254324-002