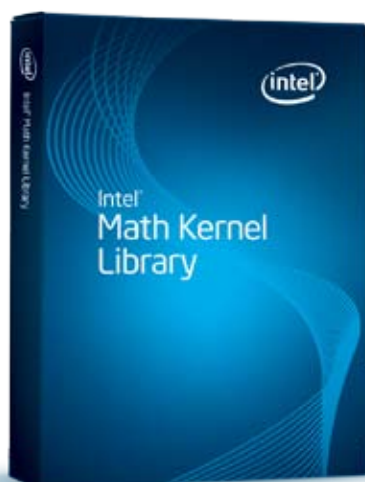


# Intel® Math Kernel Library 10.3

## Product Brief

Intel® Math Kernel Library 10.3



## The Flagship High Performance Computing Math Library for Windows\*, Linux\*, and Mac OS\* X

Intel® Math Kernel Library (Intel® MKL) 10.3 is a library of highly optimized, extensively threaded math routines that provides outstanding performance for science, engineering, and financial applications.

### Mathematical Domains Supported by Intel MKL

- Dense Linear Algebra—BLAS\*, LAPACK\*, Trust Region Solver
- Sparse Linear Algebra—Sparse BLAS, Sparse Format Converters, PARDISO\* Direct Sparse Solver, Iterative Sparse Solvers and Pre-conditioners
- Fast Fourier Transforms
- Optimized LINPACK benchmark
- Vector Math Library
- Statistics Functions - Vector Random Number Generators, Summary Statistics Library
- Cluster Support—ScaLAPACK\*, Cluster FFT

**"Intel MKL is indispensable for any high-performance computer user on x86 platforms."**

*Prof. Jack Dongarra  
Innovative Computing Lab  
University of Tennessee, Knoxville*

**"Over 80% of the Top 500 supercomputers utilize Intel processors. Intel® MKL includes features and helps unlock the performance in Intel's latest generation of CPU's."**

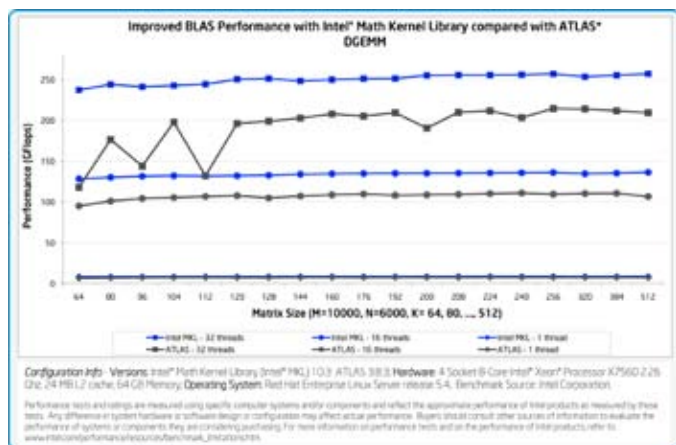
*Shane Story  
Intel MKL Engineering Manager*

# Features

Features	Benefit
<b>Performance</b>	
Enhanced Performance	Includes optimizations for Intel's latest generation of processors and helps users utilize performance enhancing features such as Intel® Advanced Vector Extensions (Intel® AVX).
Automatic Parallelization	Automatically increases application performance on multi-core processors without additional effort.
Support for Multicore Processors	Much of Intel MKL is threaded to help you get the most of today's multi-core processors. Intel MKL functions are also fully thread-safe, so multiple calls for different threads will not conflict with one another. See below for a complete list of supported CPU's.
Cluster Support	Scale your application on clusters using routines such as Cluster FFTs, Parallel BLAS (PBLAS) and Scalable LAPACK (ScaLAPACK).
Instruction Set Level Optimizations	Functions deliver performance beyond what optimizing compilers alone can deliver. For each Intel Architecture compatible processor, MKL dispatches code to take advantage of the underlying hardware features including SIMD instructions.  For detailed performance data, visit the Intel MKL product web page at <a href="http://www.intel.com/software/products/mkl">http://www.intel.com/software/products/mkl</a>
<b>Productivity</b>	
Rich Functionality	Broad support for dense Linear Algebra, Sparse Linear Algebra, Fast Fourier Transforms, Optimized LINPACK benchmark, Vector Math Library, Statistics Functions including Random Number Generators (RNG) and Cluster Support that help speed your application development.
C/C++, Fortran Support	Built-in API's to support your language of choice.
C#, .NET, Java Usage Samples	C#, .NET and Java environments supported with code wrapper examples that ease integration.
<b>Future Proofing</b>	
Support for Future Instruction Sets and Additional CPU Cores	Optimized for current multicore and future manycore processors. At the introduction of the new Intel CPU's, just re-link with the latest version of Intel MKL to achieve the greater application performance.
<b>Simple Licensing</b>	
Royalty-free Redistribution	Redistribute unlimited copies of the runtime libraries with your application.
Attractive Product Pricing	Affordable starting at US\$399, special academic pricing is also available.
<b>New Features in MKL 10.3</b>	
Support for Intel AVX	New performance optimizations for Intel AVX results in faster floating point operations in the BLAS, LAPACK, FFTs, VML, and VSL functional domains for Sandy Bridge and later processors.
Summary Statistics Library	New functions covering basic statistics, covariance and correlation, pooled, group, partial, and robust covariance/correlation, quantiles and streaming quantiles, outliers detection algorithm, and missing values support.
C Extensions for LAPACK and PARDISO	New C interfaces for all LAPACK functions supporting row-major ordering. Support for c-style (zero-based) array indexing for PARDISO data arrays.
Dynamic Accuracy Control in VML	New interfaces for each VML function including additional parameter for setting the accuracy mode.
Additional optimizations	Optimizations and enhanced capabilities across many MKL domains, PARDISO, FFTs, and VSL.

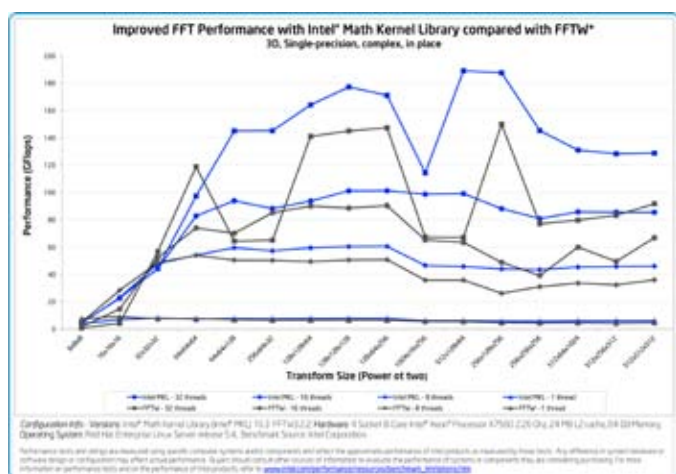
## Supported Mathematical Domains: BLAS and LAPACK

Intel MKL 10.3 provides extremely well-tuned BLAS and LAPACK implementations that deliver significant performance leadership over alternative math libraries. The standard interfaces provided match those on Netlib\* and include the latest LAPACK 3.2.2 enhancements.



## Fast Fourier Transforms (FFT)

Intel MKL Fast Fourier Transforms are highly optimized and provide significant performance gains over alternative libraries for medium and large transform sizes. Standard Intel DFTI interfaces are supported and FFTW interface wrappers provided.



## Sparse Solvers

Intel MKL 10.3 library includes both direct and iterative sparse solvers:

**Direct—PARDISO:** A threaded, high-performance, memory efficient solver for large sparse linear systems of equations. It has out-of-core memory support, as well as support for the single and double precision real and complex data types.

**Iterative—FGMRES\* and Conjugate Gradient Solvers:**

FGMRES\* adds the capability to solve general sparse systems of linear equations while the Conjugate Gradient solver solves symmetric positive-definite systems

## Vector Math Library

Intel MKL provides vector implementations of computationally intensive core mathematical functions.

## Statistics Functions

**Vector Statistical Library—Intel MKL Vector Statistical Library (VSL)** is a collection of 9 random number generators and 22 probability distributions that deliver significant performance improvements in physics, chemistry, and financial analysis. These statistical functions provide the ability to pair Random-Number Generators such as Mersenne Twister, Niederreiter with a wide variety of Probability Distributions including Uniform, Gaussian and Exponential.

**Summary Statistical Library—Intel MKL now provides** computationally intensive core/building blocks for statistical analysis, including out-of-core support. These functions include basic statistics, estimation of dependencies, data outlier detection, and missing value replacement, among other functions. These features can be used to speed up applications in computational finance, life sciences, engineering/simulations, databases, and other areas.

## Support for Clusters

**ScaLAPACK**— Intel MKL includes a highly optimized version of ScaLAPACK on clusters and delivers significant performance improvements over the NETLIB\* implementation. The pre-built interfaces eliminate the heavy-lifting required to build this complex cluster software component.

**Cluster FFT**— Support for distributed memory systems (clusters) is included with Cluster FFT.

## Optimized LINPACK benchmark

The Intel MKL package includes an optimized implementation of the LINPACK benchmark which is easy to run and demonstrates outstanding performance on the latest Intel processors.

Download a trial version of Intel MKL today.  
[www.intel.com/software/products/eval](http://www.intel.com/software/products/eval)

**“By adopting the Intel MKL DGEMM libraries, our standard benchmarks timing improved between 43 percent and 71 percent...”**

*Matt Dunbar  
Software Developer  
ABAQUS, Inc.*

### Intel® MKL is available in the following products

Intel® Parallel Studio XE 2011 (Windows, Linux)

Intel® Cluster Studio 2011 (Windows, Linux)

Intel® Composer XE 2011 (Windows, Linux)

Intel® C++ Composer XE 2011 (Windows, Linux, Mac OS X)

Intel® Fortran Composer XE 2011 (Windows, Linux, Mac OS X)

Intel® Math Kernel Library 10.3 (Windows, Linux)

## Compatibility

### Intel® Math Kernel Library Technical Specifications

Processor Support	Validated for use with multiple generations of Intel and compatible processors including but not limited to: Intel® Xeon™ Processor and Intel® Core™ processor family.
Operating Systems	Use the same API for application development on multiple operating systems: Windows*, Linux* and MAC OS* X
Development Tools and Environments	Fully compatible with other development tools from Intel such as compilers, performance and threading analyzers, and other Intel® Performance Libraries. In addition, Intel MKL is easily used and integrated with popular development tools and environments such as Microsoft Visual Studio* (2005, 2008, 2010), Xcode*, Eclipse*, and the GNU Compiler Collection* (GCC*).
Programming Languages	Natively supports Fortran, C and C++ development; cross language usage examples provided for C#/NET and Java.
System Requirements	Refer to <a href="http://www.intel.com/software/products/systemrequirements/">www.intel.com/software/products/systemrequirements/</a> for details on hardware and software requirements.
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, available here: <a href="http://www.intel.com/software/products/support/">http://www.intel.com/software/products/support/</a>
Community	Intel MKL customer forum available here: <a href="http://software.intel.com/en-us/forums/intel-math-kernel-library/">http://software.intel.com/en-us/forums/intel-math-kernel-library/</a> Share experiences with other users of Intel MKL and other parallel programming tools at the Intel moderated forum: <a href="http://software.intel.com/en-us/forums/">http://software.intel.com/en-us/forums/</a>

## Optimization Notice

The Intel® Math Kernel Library (Intel® MKL) contains functions that are more highly optimized for Intel microprocessors than for other microprocessors. While the functions in Intel® MKL offer optimizations for both Intel and Intel-compatible microprocessors, depending on your code and other factors, you will likely get extra performance on Intel microprocessors.

While the paragraph above describes the basic optimization approach for Intel® MKL as a whole, the library may or may not be optimized to the same degree for non-Intel microprocessors for optimizations that are not unique to Intel microprocessors. These optimizations include Intel® Streaming SIMD Extensions 2 (Intel® SSE2), Intel® Streaming SIMD Extensions 3 (Intel® SSE3), and Supplemental Streaming SIMD Extensions 3 (Intel® 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.

Intel recommends that you evaluate other library products to determine which best meets your requirements.

