

# ICL UT

## INNOVATIVE COMPUTING LABORATORY

THE UNIVERSITY of TENNESSEE

The Innovative Computing Laboratory (ICL) is a large Computer Science research and development group situated in the heart of the University of Tennessee's Knoxville campus. ICL's mission is to establish and maintain the University of Tennessee as a world leader in advanced scientific and high performance computing through research, education, and collaboration.



CLAXTON BUILDING  
HOME OF ICL



ICL GROUP FALL 2012

ICL's founder, Dr. Jack Dongarra, established the lab in 1989 when he received a dual appointment as a Distinguished Professor at UTK and as a Distinguished Scientist at Oak Ridge National Laboratory. Since then, ICL has grown into an internationally recognized research laboratory, specializing in Numerical Linear Algebra, Distributed Computing, and Performance Evaluation and Benchmarking. The lab now employs nearly fifty researchers, students, and staff, and has earned many accolades, including three R&D 100 awards.

## IGMCS

The University of Tennessee's Interdisciplinary Graduate Minor in Computational Science (IGMCS) offers students an opportunity to acquire the balanced package of knowledge and skills required in today's computationally intensive research methods. Through the IGMCS, graduate students can augment the curriculum of their chosen field with computationally rich courses from other science and engineering areas, creating a solid interdisciplinary foundation in Computational Science.

## CITR

The Center for Information Technology Research (CITR) was established in 2001 to drive the growth and development of leading edge information technology research at the University of Tennessee. As part of this goal, CITR staff members currently provide primary administrative support for ICL and the IGMCS, and have provided secondary support for other UT research centers.

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<http://icl.utk.edu/>

## MAIN RESEARCH AREAS

### NUMERICAL LINEAR ALGEBRA

**EASI**            **PLASMA**  
**FT-LA**         **PULSAR**  
**Keeneland**    **QUARK**  
**LAPACK**      **ScaLAPACK**  
**MAGMA**

Numerical Linear Algebra algorithms and software form the backbone of many scientific applications in use today. With the ever-changing landscape of computer architectures, such as the massive increase in parallelism and the introduction of hybrid platforms utilizing both traditional CPUs and GPUs, these libraries must be revolutionized in order to achieve high performance and efficiency on these new hardware platforms. ICL has a long history of developing and standardizing these libraries in order to meet this demand, and we have multiple projects actively underway in this arena.

### DISTRIBUTED COMPUTING

**G8 ECS**  
**GridPac**  
**OpenMPI**  
**PaRSEC**  
**ULFM**

Distributed Computing is an integral part of the high performance computing landscape. As the number of cores, nodes, and other components in an HPC system continue to grow explosively, applications need runtime systems that can exploit all this parallelism. Moreover, the drastically lower meantime to failure of these components must be addressed with fault tolerant software and hardware, and the escalating communication traffic that they generate must be addressed with smarter and more efficient message passing standards and practices. Distributed Computing research at ICL has been a priority for nearly two decades, and the lab has several projects in that arena under active development.

### PERFORMANCE EVALUATION AND BENCHMARKING

**CScADS**        **PAPI**  
**FutureGrid**    **SUPER**  
**HPCC**          **TOP500**  
**HPL**  
**MuMMI**

Performance Evaluation and Benchmarking are vital to developing science and engineering applications that run efficiently in an HPC environment. ICL's Performance Evaluation tools allow programmers to see the correlation between the structure of source/object code and the efficiency of the mapping of that code to the underlying architecture. These correlations are important for performance tuning, compiler optimization, debugging, and finding and correcting performance bottlenecks. ICL's benchmark software is widely used to determine the performance profile of modern HPC machines, and has come to play an essential role in the purchasing and management of major computing infrastructure by government and industry around the world.

#### 23 YEARS OF KEY ICL RESEARCH

1989	1992	1993	1994	1995	1997	1999	2000	2002	2003	2006	2008	2009	2010	2011	2012
<b>PVM</b> Level 3 BLAS		<b>TOP500</b>		<b>ScaLAPACK</b>		<b>PAPI</b> <b>HARNES</b>		<b>FT-MPI</b> <b>GCO</b>		<b>Open MPI</b> <b>FT-LA</b>		<b>Blackjack</b> <b>MuMMI</b>		<b>PULSAR</b>	
	<b>LAPACK</b> <b>BLACS</b>		<b>MPI</b>		<b>NetSolve</b> <b>ATLAS</b> <b>RIB</b>		<b>HPL</b>		<b>LAPACK for</b> <b>Clusters</b> <b>HPC Challenge</b>		<b>PLASMA</b> <b>MAGMA</b>		<b>DPLASMA</b>		<b>PaRSEC</b>