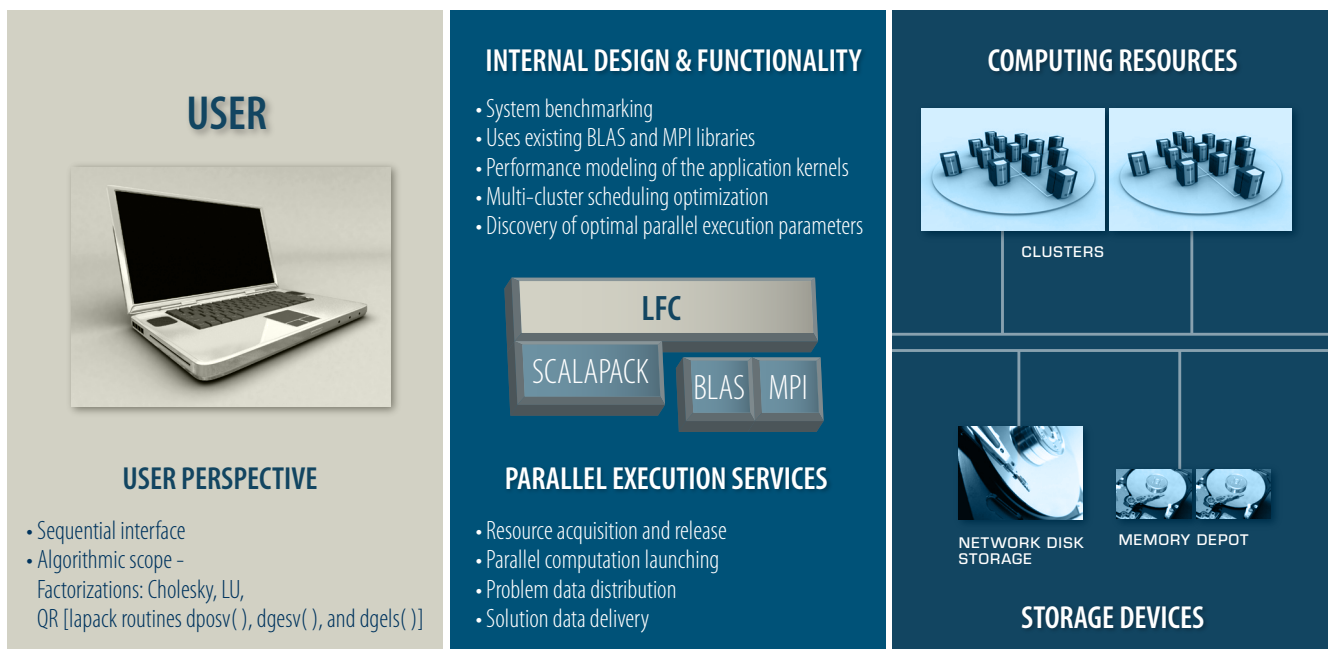


# LFC

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

## LAPACK FOR CLUSTERS

LAPACK for Clusters (LFC) brings both the performance of ScaLAPACK and the expertise of advanced performance tuning to an average user familiar with the LAPACK interface. The approach to problem solving taken by LFC hides the complexity of parallel application development, deployment, and use in a fashion similar to that of the computational grid. Encapsulation of expert knowledge in high performance parallel numerical linear algebra enables optimized use of existing hardware resources and software technologies. LFC automates solution method selection and adaptation to the problem type, the available computing power, and the data storage space. Back in 2003, LFC became part of NPACI's NPACage. In 2004, development on the client-server computational component began. By the end of 2005, LFC will have two interfaces in Matlab and Python for seamless interactive work on parallel resources.



### FUTURE DIRECTIONS

- Support for symmetric and unsymmetric eigenvalue problems
- Out-of-core computations
- Checkpointing capabilities
- Fault tolerance
- Dynamic load balancing

### RELATED PROJECTS

ATLAS	<a href="http://icl.cs.utk.edu/atlas/">http://icl.cs.utk.edu/atlas/</a>
GrADS	<a href="http://icl.cs.utk.edu/grads/">http://icl.cs.utk.edu/grads/</a>
JLAPACK	<a href="http://icl.cs.utk.edu/f2j/">http://icl.cs.utk.edu/f2j/</a>
GridSolve	<a href="http://icl.cs.utk.edu/gridsolve/">http://icl.cs.utk.edu/gridsolve/</a>
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# LFC

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## LAPACK FOR CLUSTERS

LAPACK for Clusters (LFC) is numerical software for solving linear algebra problems on tightly coupled computing clusters in a self-adapting manner. As part of ICL's SANS (Self-Adapting Numerical Software) initiative, LFC:

- simplifies the burden of configuring, tuning, and installing numerical software.
- optimizes the performance of software for a given hardware platform.
- tunes at the installation or execution time for a generic or specific data set.
- decides which resources to use based on the user's problem and the current state of the system.

The current release is 0.1.1 and includes routines for solving under-determined, over-determined, exactly determined, and symmetric positive-definite systems of linear equations and some utility routines for the cluster. LFC merges the ease of use of LAPACK with parallel processing capabilities of ScaLAPACK, without the latter's software dependences other than BLAS and MPI implementations. It is self-contained package with built-in knowledge of how to run linear algebra software on a cluster.

The LFC software initially supported C API through a serial, single processor user interface but delivered the computing power achievable by an expert user working on the same problem who optimally utilizes the resources of a cluster. The basic premise is to design numerical library software that addresses both computational time and space complexity issues on the user's behalf and in a manner as transparent to the user as possible. The software assists the user in resolving linker dependencies when linking against an archived library of executable routines. The user is assumed to call one of the LFC routines from a serial environment while working on a single processor of the cluster, then the software executes the application. If it is possible to finish executing the problem faster by mapping the problem into a parallel environment, then this is the thread of execution taken. Otherwise, the application is executed locally with the best choice of a serial algorithm.

The following details for parallelizing the user's problem are all handled by the software:

- resource discovery and monitoring,
- selection and allocation,
- mapping the data onto (and off of) the working cluster of processors,
- executing the user's application in parallel,
- freeing the allocated resources,
- returning control of the user's process in the serial environment from which the procedure began.

Back in 2003, LFC became part of NPACI's NPACkage, which is a supported bundle of tools and other applications developed by NPACI and its research partners. The supported platforms are running IBM's AIX, Linux, or Sun's Solaris. The NPACkage serves as a substantial portion of the software stack being used in the global grid infrastructure, including the TeraGrid.

Year 2004 marked the beginning of the development of LFC's client-server component. It brings an interactive mode to the existing sequential interface and allows a completely new way of control over parallel resources and large user data.

In 2005, the client-server component may be accessed from both Matlab and Python using both the interactive shells and script files. The available functionality encompasses ScaLAPACK's solvers for various linear systems, SVD, and eigenvalue problems, as well as factorization codes; all this in real and complex arithmetic in single and double precision.