GOAL AND STATUS OF THE TLSE PLATFORM

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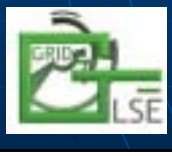
http://www.irit.enseeiht.fr/tlse
http://graal.ens-lyon.fr/LEGO



REDIMPS workshop help in conjunction with NEGST Workshop, Tokyo, May 2007

Outline

- Overview of the GRID-TLSE Project
- Semantic description of services
- Use of scenarios to generate dynamic workflows
- Bibliography
- Status
- Conclusion

GRID-TLSE Project: Tests for Large Systems of Equations

Main purpose: Sparse linear algebra Web expert site.

- GRID-TLSE Project: ACI GRID, 01/03 – 01/06. Academic partners: CERFACS, IRIT, LaBRI, LIP-ENSL;
- Now:
  - ANR-CICG05-11 LEGO Project 2006- 2009. Academic partners: LIP, IRISA, INRIA Futurs, IRIT, CERFACS, CRAL.
  - ANR-06-CIS6-010 SOLSTICE Project 2007-2010. Partners: INRIA, CERFACS, INPT-IRIT, CEA-CESTA, EADS CCR, EDF, CNRS-CNRM-LA.
  - CNRS / JST REDIMPS Project 2007-2009. Partners: JAEA and academic partners of the TLSE Project (CERFACS, IRIT, LaBRi / INRIA Futurs, LIP ENS Lyon / INRIA)

Sparse Matrices Expert Site ?

- Expert site: Help users in choosing the right solvers and its parameters for a given problem
- Chosen approach: Expert scenarios which answer common user requests
- Main goal: Provide a friendly test environment for expert and non-expert users of sparse linear algebra software.
- Easy access to:
  - Software and tools;
  - A wide range of computer architectures;
  - Matrix collections;
  - Expert Scenarios.
- Also : Provide a testbed for sparse linear algebra software

Why do we use a Grid ?

- Sparse linear algebra software makes use of sophisticated algorithms for (pre-/post-) processing the matrix.
- Multiple parameters interfere for efficient execution of a sparse direct solver:
  - Ordering;
  - Amount of memory;
  - Architecture of computer;
  - Libraries available.
  - Determining the best combination of parameter values is a multi-parametric problem.
- *Well-suited for execution over a Grid*.

Additional Benefits of Using a Computational Grid

Provides access to:

- Large range of software and tools (academic or industrial);
- Wide range of architectures;
- Computational resources.

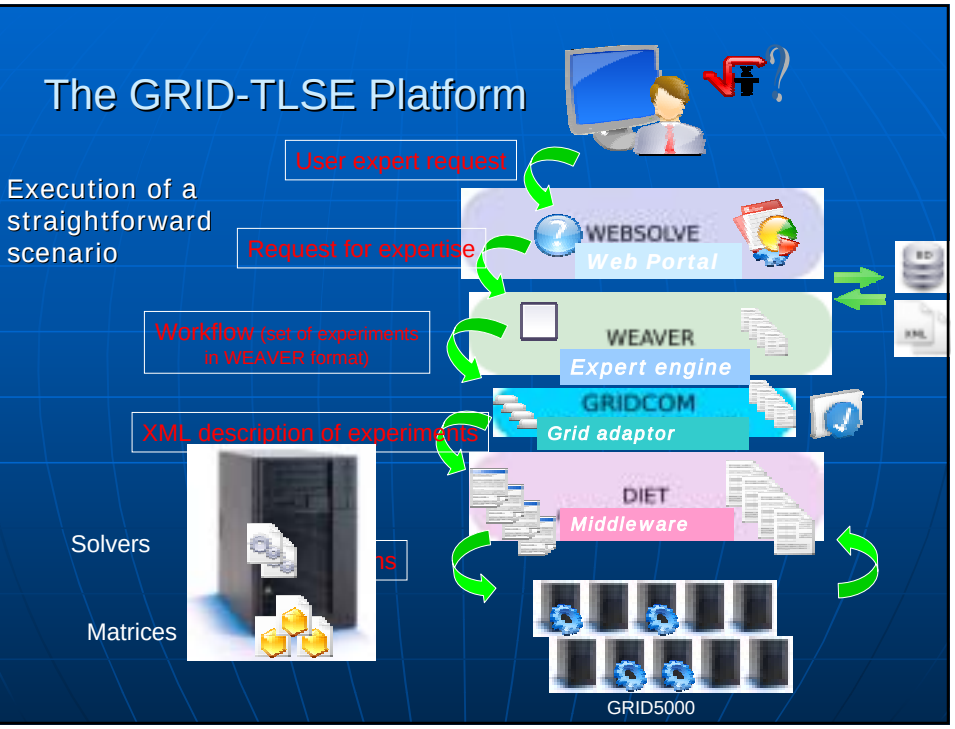
Examples of user request

- Memory required to factor a given matrix.
- Error analysis as a function of the threshold pivoting value
- Minimum time on a given computer to factor a given unsymmetric matrix
- Which ordering heuristic is the best one for solving a given problem?

Two types of users:

- Standards users that want to proceed to some tests over their matrices
- Experts that deploy tools and specify what is the expert procedure

The GRID-TLSE Platform



Key ideas in describing expert procedures

- We do not want asking an expert in sparse linear algebra to deploy services over the grid at the usual level i.e. describing interfaces, GridRPC calls, . .
- We have then introduced:
  - A high level - graphical - description of the expert process that we call scenarios
  - A semantic based description of software, control parameters and matrices based on meta-data

Main Software Issues

- The same interface provides the users with access to
  - several expertise scenarios;
  - several solvers and their parameters (using middleware to access the GRID).
- Experts provide scenarios which
  - reduce the combinatorial nature;
  - produce useful synthetic comparison.
- It should be easy to
  - add new solvers which can be used by old scenarios;
  - add new scenarios which use old solvers;
  - use the characteristics of new solvers in new scenarios.

Semantic-based description

- Meta-data which describe for each package:
  - To describe a service:
    - functionalities: assembled/elemental entries, type of factorisations (LU, LDL^T ,QR), multiprocessor, multiple RHS;
    - algorithmic properties: unsymmetric/symmetric solver, multifrontal, left/right looking, pivoting strategy.
  - To describe a scenario in addition to service parameters:
    - metrics: memory, numerical precision, time, …
    - control: type of graph for post-processing, user level
- Addition of new meta-data and possible values should be easy

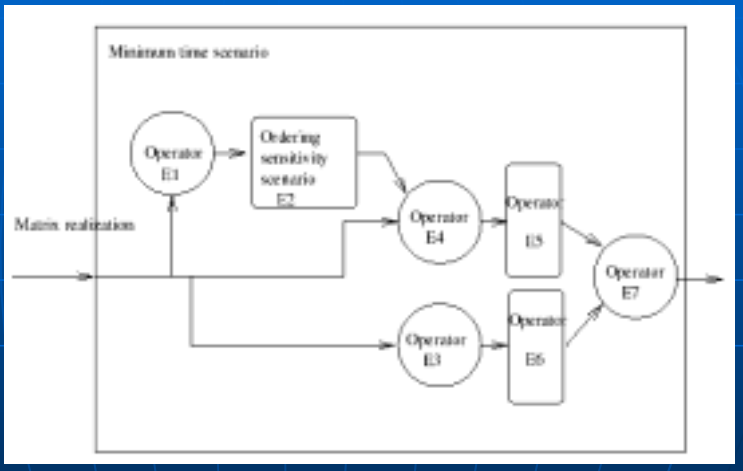
PRUNE : Web interface for editing abstract parameters

Expert Scenarios

- Scenarios described in a data-flow like way
- Structured hierarchically: a scenario may call existing ones
- Analysis / execution of a scenario may have several steps
- We have introduced:
  - Characteristics (e.g. number of flops, memory, . . .)
  - Operators: Transformation, Filtering, Generation
  - . . .

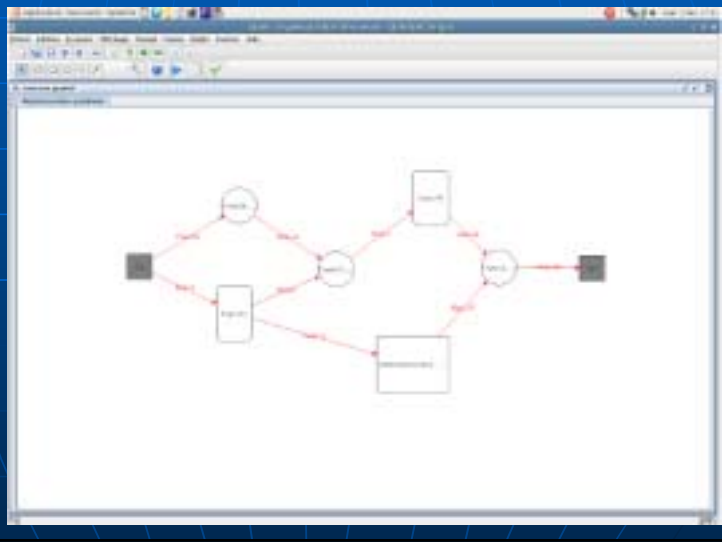
Graphical Description of Scenarios

Figure: Example of description of an expert scenario corresponding to the Minimum Time Scenario.

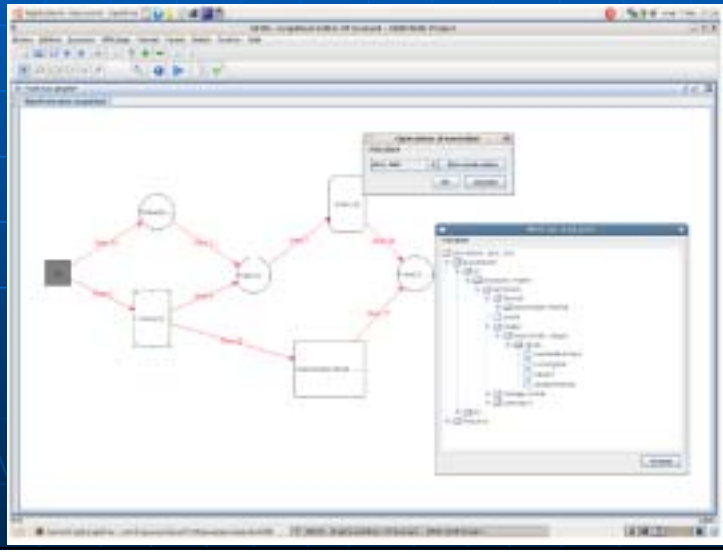


Goal: identify the combination of ordering and factorization that provides the minimal execution time.

Graphical Interface for Describing ExpertiseScenarios (GEOS)



Relationship between GEOS and PRUNE



Bibliography tool

- Advanced tools for managing bibliography (bibtex, html, …)
- Allowing:
  - Commit of references
  - Management of bibtex and indexes
  - Checking for duplicated references
  - …..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I.-S.-Duff and U.-Nowak On sparse solvers in a stiff integrator of extrapolation type 1987 -BibTeX- -Detail-
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H.-J.-Daydé [e] and I.-S.-Duff Use of [L]evel 3 [BLAS] in [LU] factorization on the [CRAY]-2, the [F]TA 10 [F], and the [IBM] [3090/VF] 1988 -BibTeX- -Detail-
I.-S.-Duff and A.-H.-Erisman and C.-W.-Gear and J.-K.-Reid Sparsity structure and [Gaussian] elimination 1988 -BibTeX- -Detail-
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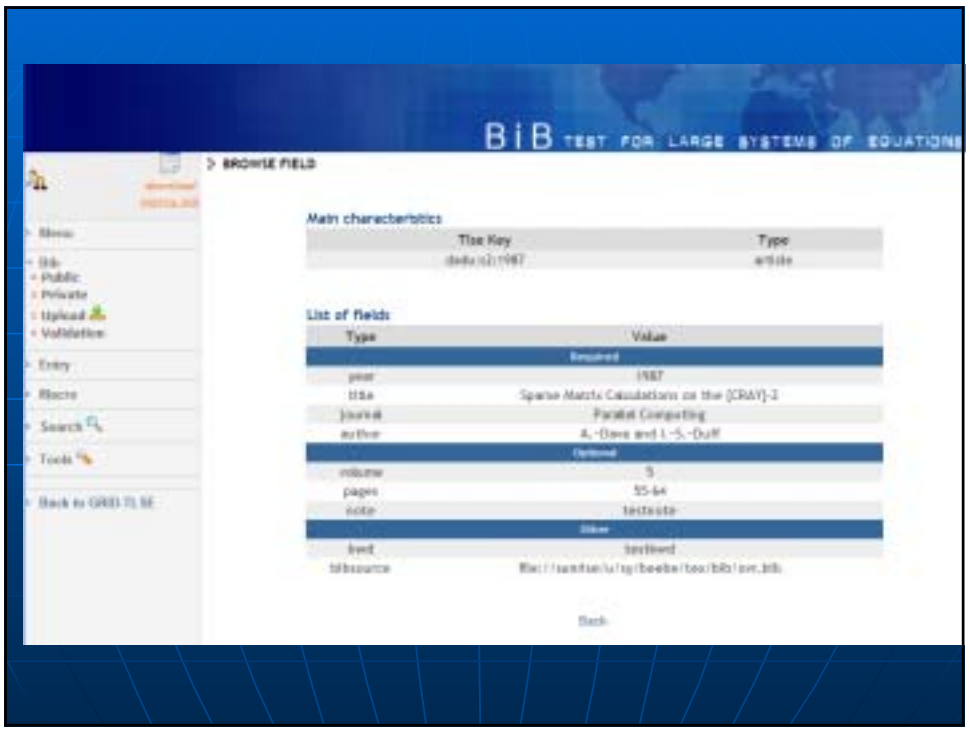
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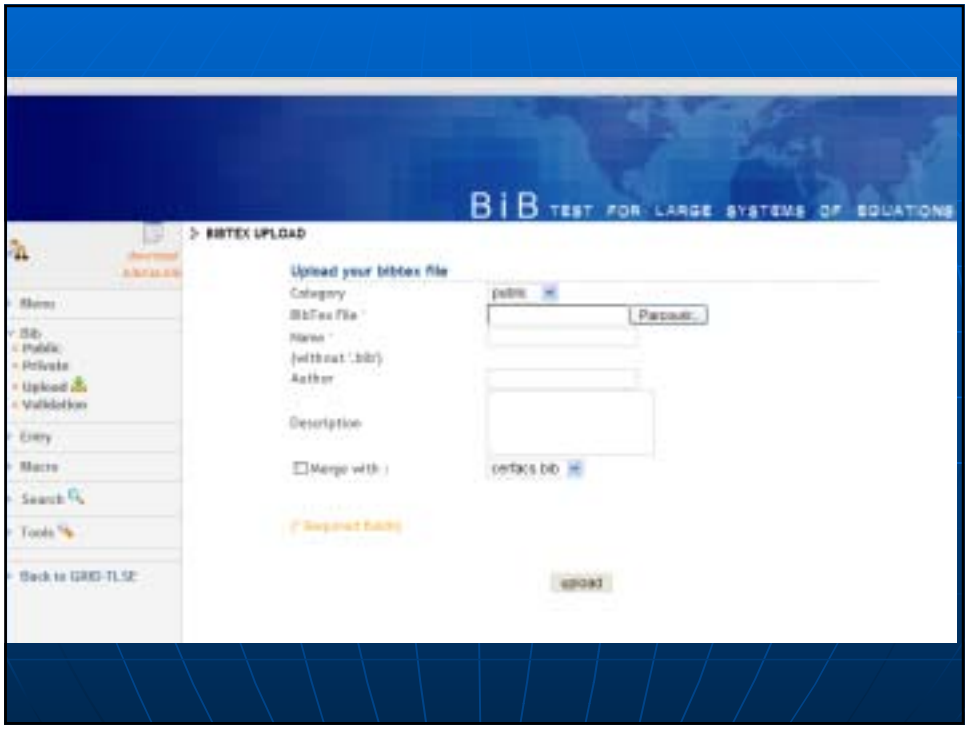
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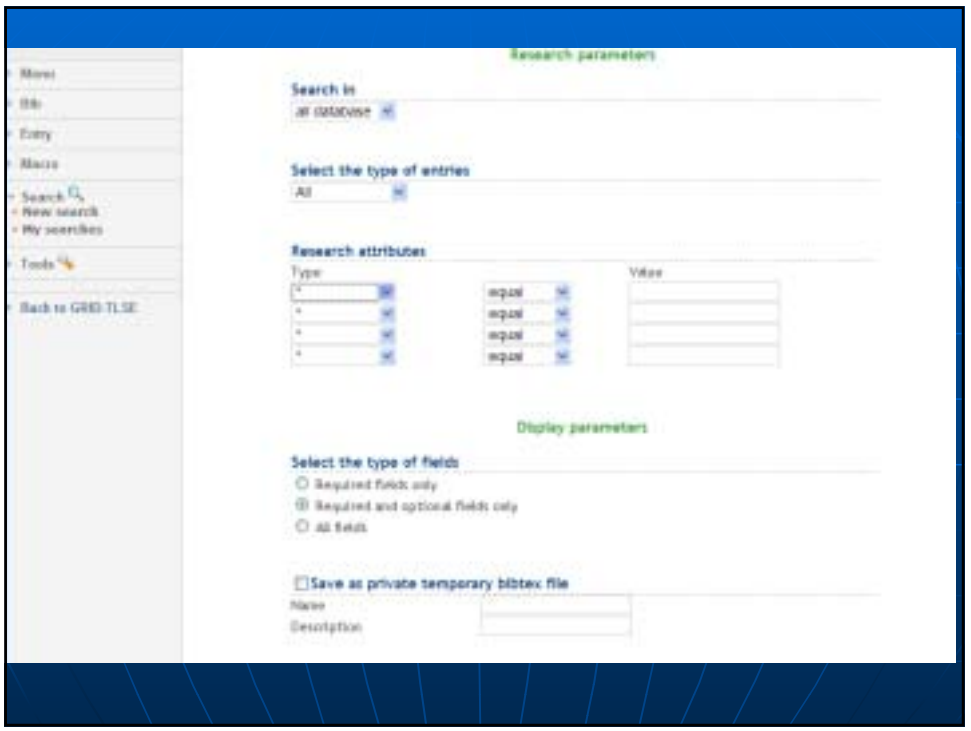
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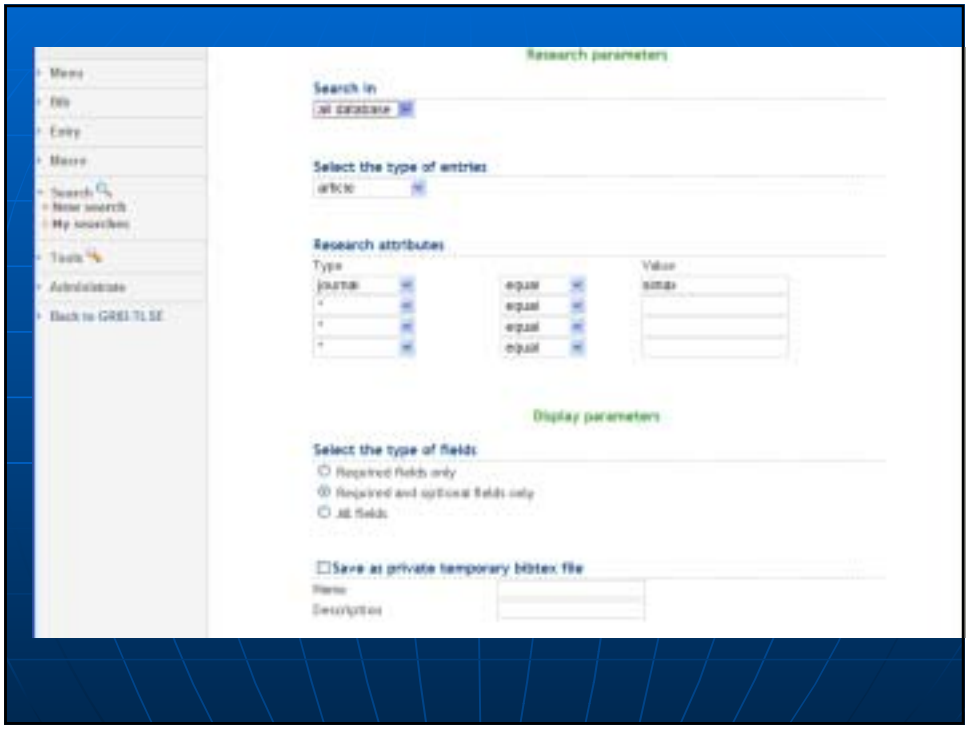
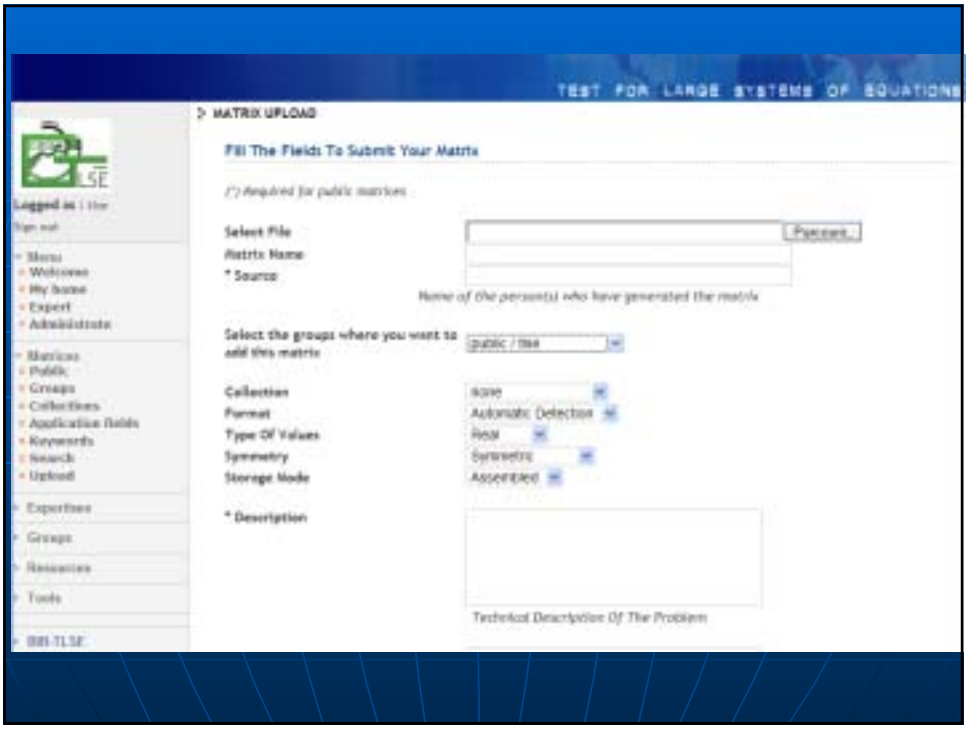


Status of the TLSE Platform

- Final version is currently be assembled and tested
- Parts of the Web sire are available:
  - Upload for matrices including validation
  - Bibliography tool


TEST FOR LARGE SYSTEMS OF EQUATIONS
> MATRIX UPLOAD
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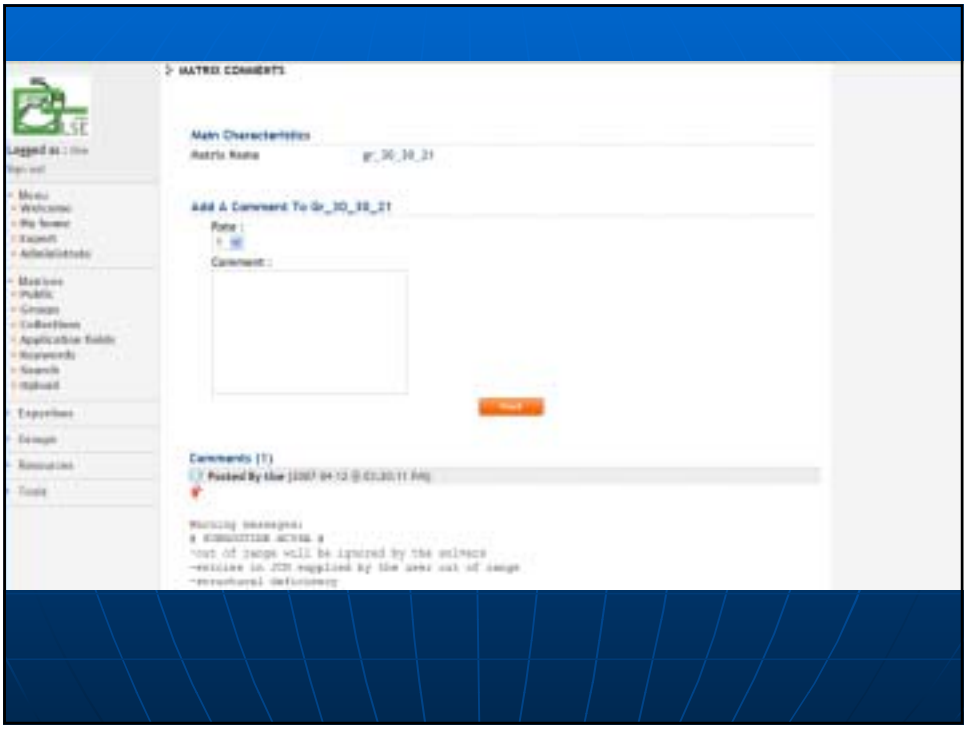
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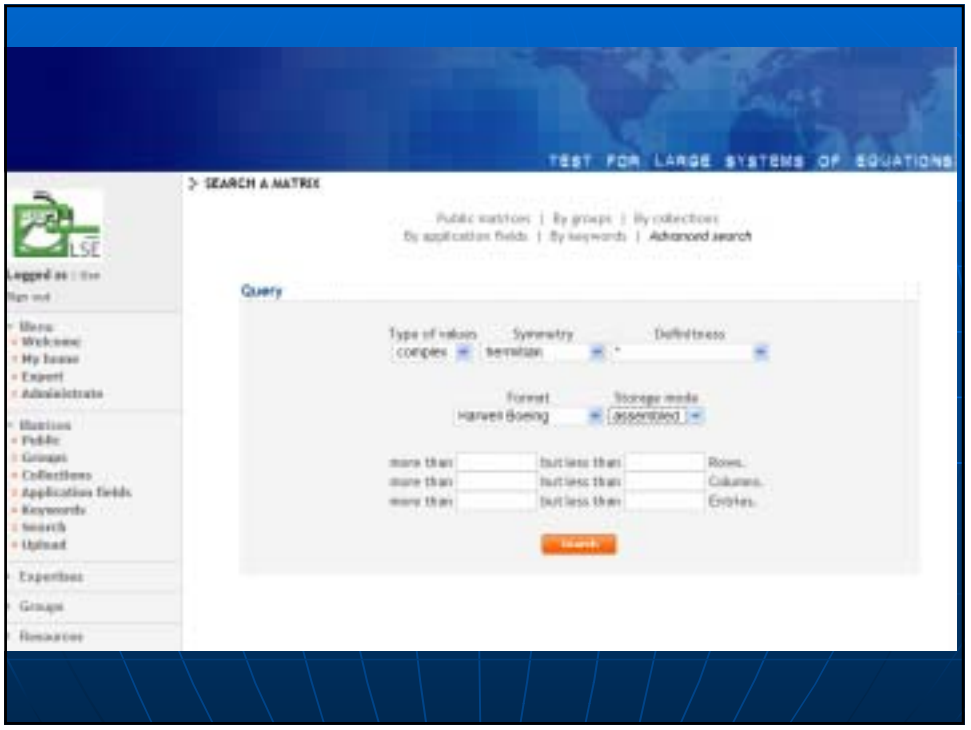
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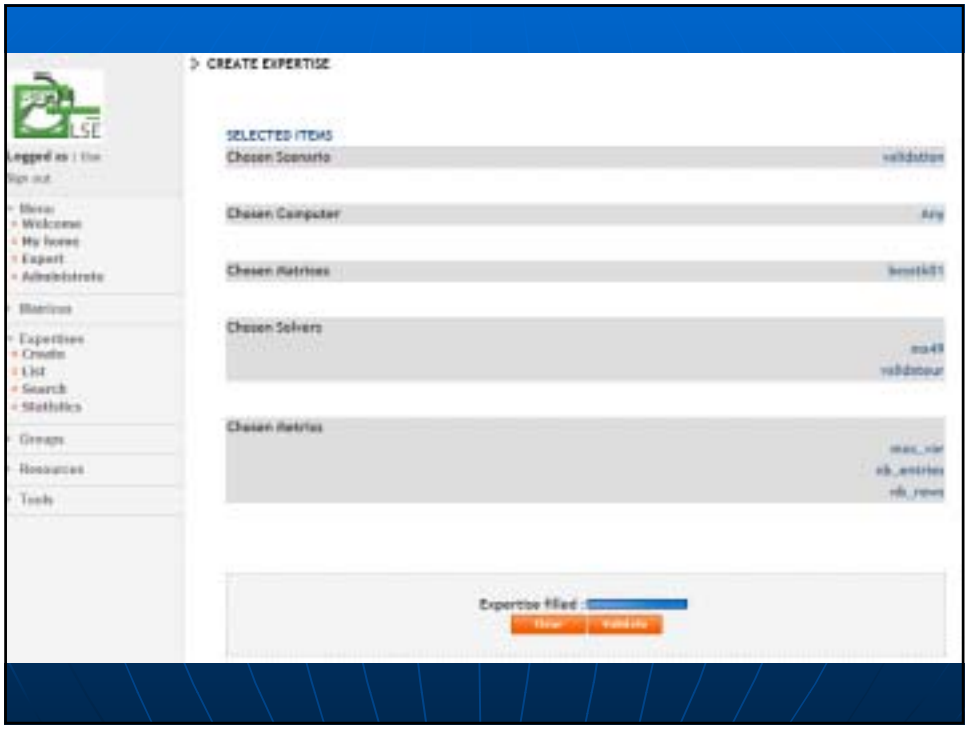
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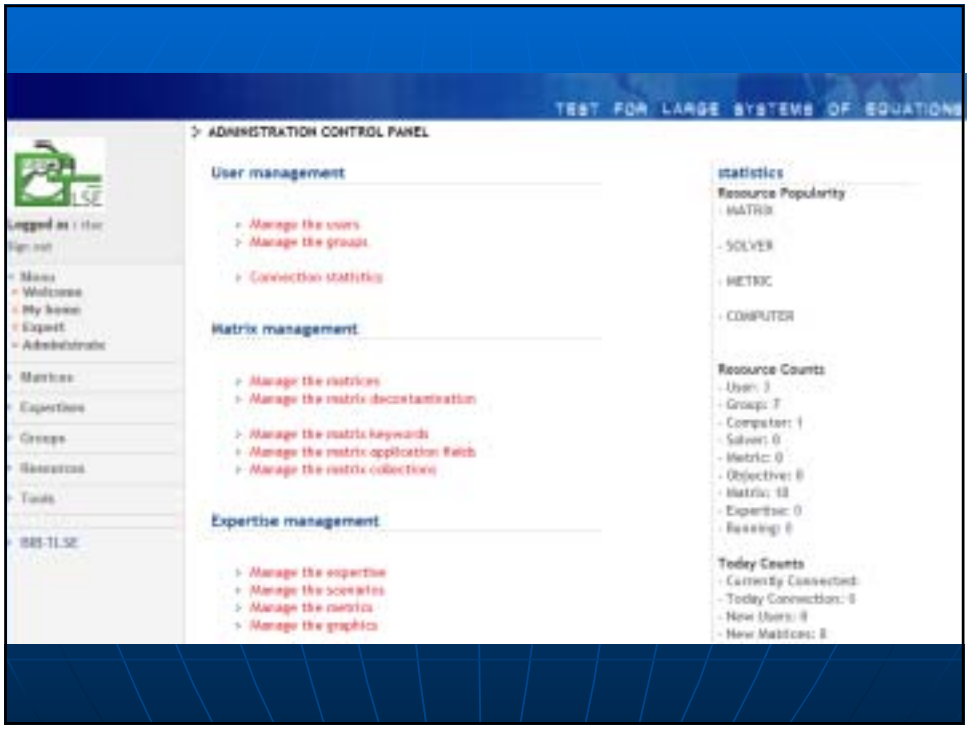

Sparse solvers

- Solver packages installations:
  - Currently in TLSE: MUMPS, SuperLU, UMFpack;
  - Being integrated: TAUCS;
  - Future: HSL MAxx, PaStiX, SPOOLES, OBLIO, PARDISO, . . .

Conclusion

- Key points: high level description of scientific software and use of scenarios for generating dynamic workflows
- Practical consequences:
  - Adding / removing solvers does not require to update scenarios (it will be automatically discovered)
  - Introduction of new scenarios make use of deployed software
  - The approach described is intended to be generic: we explore the use of this approach in other areas

REDIMPS Project

- TLSE can be used as a prediction system for sparse solvers -> increased efficiency in solving problems in physics and engineering
- JAEA is promoting grid research (ITBL) and developing sparse solvers
- All partners (JAEA, CERFACS, IRIT, LIP, LaBRI) are / will be involved in validation and testing of the first release of TLSE
- Goal: promotion of an international expert system for sparse linear algebra