Component Integration and Optimization

LACSI Priorities and Strategies Workshop 2005

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http://lacsi.rice.edu/meetings/internal/slides_feb05/components.pdf

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Plan for FY 05

- **Refocus on Marmot as Component Challenge Problem**
  - Interactions at Monterrey Workshop and a follow-up meeting at LANL (June 2004)
  - Abstract Mesh data structure to increase flexibility
  - Develop plan for activity by Q4 FY04

- **Supporting Technologies for Component Integration**
  - Transformation systems to eliminate overheads due to abstraction
  - Component integration systems to automate specialization
    - Key problem: integration of data structure components with functional components

- **Retargetable High Performance Components**
  - Pretuning arbitrary apps to new architectures

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Component Integration

- **Supporting Technologies for Component Integration**
  - —Transformation systems to eliminate overheads due to abstraction
  - —Component integration systems to automate specialization
    - – Key problem: integration of data structure components with functional components

- **Continue Collaborations with Marmot Project**
  - —Pursue directions in the draft collaboration plan (next slide)
  - —Application of object-oriented optimization strategies (from JaMake)

- **New LANL Contact from Traditional Code Projects**

- **Challenge Application**
  - —Export-restricted version of hydro+radiation transport
  - —Representative of "traditional" code projects

New Directions

- **Specialization Strategies**
  - Specialized handling of multiple materials in cells
  - Compiler-based specialization to sparse data structures
  - Combined telescoping languages and dynamic code selection
    - Optimization by limited computation reorganization

- **Tools for Preoptimization of Libraries**
  - Pre-specialization of library codes to expected calling contexts
  - Potential source of components: Trillinos

- **Mining of Traditional Applications**
  - Construction of libraries for inclusion in domain languages

- **Rapid Prototyping Support**
  - Compilation of scripting languages (Python, Matlab) to Fortran/C

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Automatic Component Tuning

- **Participants: Four Groups within LACSI**
  - **Tennessee: Jack Dongarra**
    - **Collaboration with LLNL ROSE Group (Dan Quinlan, Qing Yi)**
  - **Rice: Ken Kennedy and John Mellor Crummey**
    - **Students Apan Qasem and Yuan Zhao**
  - **Rice: Keith Cooper, Devika Subramanian, and Linda Torczon**
    - **Students Todd Waterman and Alex Grosul**
  - **Univ of Houston: Lennart Johnsson**
    - **Students Ayaz Ali, Purvi Shah, Haiyan Teng**

Automatic Tuning Plan

- **Retargetable High Performance Components**
  - Pretuning components to new architectures
    - Arbitrary components: Heuristic search strategies
    - Structural approach: refactor the component into codelets
  - Fault Tolerant Algorithms

- **Connection to LANL**
  - Point of contact within LANL from "traditional" code projects
  - Release of kernels from code projects (export restricted?)

- **Autotuning Challenge**
  - Four teams within LACSI will apply techniques to the LANL kernels

- **Longer Term**
  - Application to component integration challenge application

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Planned Workshops

- **Automatic Tuning**
  - LACSI Groups
    - Rice, UH, Tennessee
  - Cornell-UIUC (Pingali and Padua)
  - USC ISI (Mary Hall)

- **Parallel Scripting Languages**
  - Through DARPA HPCS
  - Matlab Groups
    - MIT (Kepner)
    - Tennessee (Dongarra)
    - Rice (Kennedy, Mellor-Crummey, Fowler)
    - OSC-Indiana-PNL (Ahalt, Sadayappan, Chauhan)

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