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# SuperMatrix

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On Optimizing Collective Communication

Ernie Chan, Manoj F. Bhaskar, Avi Parkuram, and Robert A. van de Geijn

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Abstract In this paper we discuss issues related to the high-performance implementation of collective communication operations in distributed-memory systems.

1 Introduction

In this paper we discuss a collection of optimization techniques for the implementation of collective communication operations in distributed-memory systems.

2 Model of parallel computation

Collective communication operations in distributed-memory systems are implemented in a variety of ways.

3 Performance

Network effects It is important that the path between the nodes of the communication tree be as short as possible.

4 Conclusions

References

Ernie Chan, Manoj F. Bhaskar, Avi Parkuram, and Robert A. van de Geijn

10th European Conference on Parallel, Distributed and Network-Based Computing

Scheduling of QR Factorization Algorithms on SMP and Multi-Core Architectures

Gregorio Quintana-Orti, Enrique S. Quintana-Orti, and Robert A. van de Geijn

Abstract This paper describes the parallel scheduling of QR factorization algorithms on SMP and multi-core architectures.

1 Introduction

QR factorization is a fundamental operation in many scientific and engineering applications.

2 QR factorization algorithms

QR factorization algorithms can be implemented in a variety of ways.

3 Parallel scheduling

Parallel scheduling of QR factorization algorithms is a challenging task.

4 Conclusions

References

Ernie Chan, Manoj F. Bhaskar, Avi Parkuram, and Robert A. van de Geijn

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Managing the Complexity of Lookahead for LU Factorization with Pivoting

Ernie Chan and Robert van de Geijn

Abstract This paper discusses the complexity of lookahead for LU factorization with pivoting.

1 Introduction

LU factorization with pivoting is a fundamental operation in many scientific and engineering applications.

2 Complexity of lookahead

The complexity of lookahead for LU factorization with pivoting is a challenging task.

3 Conclusions

References

Ernie Chan and Robert van de Geijn

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## SOFTWARE ENGINEERING

### The liblame Library for Dense Matrix Computations

Researchers from the Formal Linear Algebra Method Environment (FLAME) project have developed new techniques for analyzing, designing, and implementing linear algebra libraries. These solutions, which we call the liblame library, seem to solve many of the programmability problems that have arisen with the advent of multicore and many-core architectures.

How do we construct a good library for a programmable and/or many-core architecture? This is a challenging question that has been asked many times in the past.

One of the main goals of the liblame library is to provide a high-level interface to the underlying hardware.

The liblame library is designed to be portable and to support a wide range of hardware architectures.

The liblame library is implemented in a way that allows it to be used in a variety of contexts.

The liblame library is a good example of how to design a library for a programmable and/or many-core architecture.

References

Ernie Chan, Robert van de Geijn, and Gregorio Quintana-Orti

10th European Conference on Parallel, Distributed and Network-Based Computing

Satisfying Your Dependencies with SuperMatrix

Ernie Chan, Field G. Van Zee, Enrique S. Quintana-Orti, Gregorio Quintana-Orti, Robert van de Geijn

Abstract This paper discusses the challenges of satisfying dependencies in SuperMatrix.

1 Introduction

SuperMatrix is a high-performance linear algebra library that supports a wide range of hardware architectures.

2 Dependencies

Dependencies are a key challenge in the design of SuperMatrix.

3 Satisfying dependencies

Satisfying dependencies in SuperMatrix is a challenging task.

4 Conclusions

References

Ernie Chan, Field G. Van Zee, Enrique S. Quintana-Orti, Gregorio Quintana-Orti, Robert van de Geijn

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Design of Scalable Dense Linear Algebra Libraries for Multithreaded Architectures: the LU Factorization

Gregorio Quintana-Orti, Enrique S. Quintana-Orti, and Robert A. van de Geijn

Abstract This paper discusses the design of scalable dense linear algebra libraries for multithreaded architectures.

1 Introduction

Scalable dense linear algebra libraries are essential for many scientific and engineering applications.

2 Design challenges

Designing scalable dense linear algebra libraries is a challenging task.

3 Conclusions

References

Ernie Chan, Field G. Van Zee, Enrique S. Quintana-Orti, Gregorio Quintana-Orti, Robert van de Geijn

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Transforming Linear Algebra Libraries: From Abstraction to Parallelism

Ernie Chan, Robert van de Geijn, and Field G. Van Zee

Abstract This paper discusses the transformation of linear algebra libraries from abstraction to parallelism.

## Collective communication: theory, practice, and experience

Ernie Chan<sup>1</sup>, Manoj F. Bhaskar<sup>2</sup>, Avi Parkuram<sup>2</sup> and Robert van de Geijn<sup>1</sup>

<sup>1</sup>Department of Computer Science, The University of Texas at Austin, Austin, TX 78712, U.S.A. <sup>2</sup>Texas Advanced Computing Center, The University of Texas at Austin, Austin, TX 78712, U.S.A.

Abstract This paper discusses the theory, practice, and experience of collective communication.

1 Introduction

Collective communication is a fundamental operation in many scientific and engineering applications.

2 Theory

The theory of collective communication is a challenging task.

3 Practice

Practical issues in the implementation of collective communication are discussed.

4 Experience

Our experience with the implementation of collective communication is shared.

5 Conclusions

References

Ernie Chan, Manoj F. Bhaskar, Avi Parkuram, and Robert A. van de Geijn

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Collective Communication on Architectures that Support Simultaneous Communication over Multiple Links

Ernie Chan, Robert van de Geijn, William Gemp, Rajeev Thakur

Abstract This paper discusses collective communication on architectures that support simultaneous communication over multiple links.

1 Introduction

Simultaneous communication over multiple links is a key feature of many modern architectures.

2 Challenges

Designing for simultaneous communication over multiple links is a challenging task.

3 Solutions

Solutions for simultaneous communication over multiple links are discussed.

4 Conclusions

References

Ernie Chan, Robert van de Geijn, William Gemp, Rajeev Thakur

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SuperMatrix: A Multithreaded Runtime Scheduling System for Algorithms-by-Blocks

Ernie Chan, Field G. Van Zee, Paolo Brinchi, Enrique S. Quintana-Orti, Gregorio Quintana-Orti, and Robert van de Geijn

Abstract This paper discusses SuperMatrix, a multithreaded runtime scheduling system for algorithms-by-blocks.

1 Introduction

SuperMatrix is a high-performance linear algebra library that supports a wide range of hardware architectures.

2 Scheduling

The scheduling of SuperMatrix is a challenging task.

3 Conclusions

References

Ernie Chan, Field G. Van Zee, Paolo Brinchi, Enrique S. Quintana-Orti, Gregorio Quintana-Orti, Robert van de Geijn

10th European Conference on Parallel, Distributed and Network-Based Computing

## Programming Matrix Algorithms-by-Blocks for Thread-Level Parallelism

Gregorio Quintana-Orti and Enrique S. Quintana-Orti

Abstract This paper discusses programming matrix algorithms-by-blocks for thread-level parallelism.

1 Introduction

Matrix algorithms-by-blocks are a key feature of many modern architectures.

2 Challenges

Designing for matrix algorithms-by-blocks is a challenging task.

3 Solutions

Solutions for matrix algorithms-by-blocks are discussed.

4 Conclusions

References

Ernie Chan, Field G. Van Zee, Enrique S. Quintana-Orti, Gregorio Quintana-Orti, Robert van de Geijn

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Design of Scalable Dense Linear Algebra Libraries for Multithreaded Architectures: the LU Factorization

Gregorio Quintana-Orti, Enrique S. Quintana-Orti, and Robert A. van de Geijn

Abstract This paper discusses the design of scalable dense linear algebra libraries for multithreaded architectures.

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Scalable dense linear algebra libraries are essential for many scientific and engineering applications.

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Managing the Complexity of Lookahead for LU Factorization with Pivoting

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Abstract This paper discusses the complexity of lookahead for LU factorization with pivoting.

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