Structured Approaches for Problems of Network Design and Utilization

Michael A. Langston

The University of Tennessee
404 Andy Holt Tower
Knoxville, TN 37996-0140

Washington State University
Office of Grant & Research Development
Pullman, WA 99164-3140

Basic research has been conducted in the design and analysis of algorithms. Fundamental questions in computer software and systems research have been addressed, concentrating on two particularly promising areas:

1. practical approaches to problems for which only the existence of asymptotically fast algorithms is guaranteed and
2. efficient strategies for parallel computing in realistic, resource-bounded environments.

The former is motivated by dramatic recent results in discrete mathematics. The latter is driven by continuing advances in parallel computer architectures.

This document has been approved for public release and sale; its distribution is unlimited.

Abstract (Maximum 200 words)
Final Technical Report
ONR Contract Number N00014-88-K-0343
01 May 1988 – 30 April 1991

Michael A. Langston
Department of Computer Science
University of Tennessee

Key Results

We have designed constructivization strategies with which it is now possible in principle to write down asymptotically-fast decision and search algorithms for problems previously known only to possess such methods. Thus this development eliminates the nonconstructive nature of tools previously required.

We have designed new parallel algorithms that simultaneously optimize both parallel time and parallel space. Thus our methods attain linear speedup and yet only require a constant amount of extra space per processor, even when the number of processors is bounded (as it of course is in practice).

Productivity Statistics

- Publications
  - Refereed papers published: 23
  - Refereed papers submitted but not yet published: 4
  - Unrefereed reports and articles: 6

- Technical reports: 18
- Book chapters: 4
- Grad students: 6
- Significant presentations: 8
Representative Publications


- B.-C. Huang and M. A. Langston, “Practical In-Place Merging,” *Communications of the ACM* 31 (1988), 348–352. This publication devised an elegant solution to a difficult problem, has been widely cited, and produced new methods now adopted in textbooks.


- X. Guan and M. A. Langston, “Time-Space Optimal Parallel Merging and Sorting,” *IEEE Transactions on Computers* 40 (1991), 596–602. This publication described new PRAM-style algorithms for real parallel machines, provided a foundation for many subsequent results, and has helped bridge the gap between theory and practice.

Software Produced

- Programs for obstruction set isolation and verification. This package automates exhaustive case-checking, greatly expands the horizon of feasible computation, and serves as a testbed for self-reduction methods.

- Time-space optimal parallel merging routines. This package has been implemented on both shared-memory and distributed-memory machines, scales with problem size, and highlights synchronization bottlenecks.