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### JACM - Journal of the ACM (JACM)

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

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Volume 67, Issue 1 • January 2020 • Current Issue • Issue Archive



**Publisher:** Association for Computing Machinery

**ISSN:** 0004-5411

**EISSN:** 1557-735X

**Tags:** Computations on matrices

## Sections

Volume 67, Issue 1  
January 2020

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SECTION: Scientific and High Performance Computing

SECTION: Design and analysis of algorithms

SECTION: Database Systems and Theory

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Elaye Karstadt, Oded Schwartz

January 2020, Article No.: 1, pp 1–31 • <https://doi.org/10.1145/3364504>

Strassen's algorithm (1969) was the first sub-cubic matrix multiplication algorithm. Winograd (1971) improved the leading coefficient of its complexity from 6 to 7. There have been many subsequent asymptotic improvements. Unfortunately, most of these ...

0 1



### SECTION: Design and analysis of algorithms

RESEARCH-ARTICLE [Fully Functional Suffix Trees and Optimal Text Searching in BWT-Runs Bounded Space](#)

Travis Gagie, Gonzalo Navarro, Nicola Prezza

January 2020, Article No.: 2, pp 1–54 • <https://doi.org/10.1145/3375890>

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### SIGACCESS - Special Interest Group on Accessibility and Computing

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The ACM Special Interest Group on Ada Programming Language provides a forum on all aspects of the Ada language and technologies, including usage, education, standardization, design methods, and compiler implementation. SIGAda's annual conference addresses Ada's role in building industrial-strength applications that support mission-critical, safety-critical, real-time, high-assurance, and high-integrity requirements. Supporting technologies that SIGAda focuses on include software engineering, software development processes, object-oriented programming, computer science education, tools, Common Object Request Broker Architecture (CORBA), and Java.

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Home > SIGs > SIGAI

## SIGAI • Special Interest Group on Artificial Intelligence

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276.152

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*intelligence* features new writing and ideas from a broad spectrum of the AI community. This magazine was formerly *SIGART*...

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**ACM SIGART Bulletin**  
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## ACM Conferences

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### ACM SE - ACM Southeast Regional Conference

ACM Southeast Regional Conference the oldest, continuously running, annual conference of the ACM. ACMSE provides an excellent forum for both faculty and students to present their research in a friendly and dynamic atmosphere in all areas of computer science.

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ANCS is a systems-oriented research conference, presenting original work that explores the relationship between the architecture of modern computer networks and the architecture of the individual hardware and software elements from which these networks are built. This year's conference will particularly emphasize insight into broader systems issues in its paper selection, to recognize and foster the growth of research that lies at the intersection of computer and network systems architecture.

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### APGV - Applied Perception in Graphics & Visualization

Research in computer graphics and visualization has great potential to benefit from, and contribute to, research in perception. This symposium has brought together researchers from the fields of perception, graphics and visualization, to facilitate a wider exchange of ideas. Our goals are to use insights from perception to advance the design of methods for visual, auditory and haptic representation, and to use computer graphics to enable perceptual research that would otherwise not be possible. To receive information and updates about APGV, you may subscribe to the APGV mailing list by sending an email to this address. To unsubscribe, send an email to this other address. Research in computer graphics and visualization has great potential to benefit from, and contribute to, research in perception. This symposium has brought together researchers from the fields of perception, graphics and visualization, to facilitate a wider exchange of ideas. Our goal

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"image processing"

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RESEARCH-ARTICLE [Image processing](#)

Andrew Tescher

AFIPS '80: Proceedings of the May 19-22, 1980, national computer conference • May 1980, pp 369 • <https://doi.org/10.1145/1500518.1500578>



NCC '80 has addressed three important areas of image processing through individually organized sessions.

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5. เพิ่มคำค้นเพิ่มเติม เพื่อกรองผลลัพธ์ให้แคบลง

## with applications to image analysis and automated cartography



**Authors:**  [Martin A. Fischler](#),  [Robert C. Bolles](#) [Authors Info & Affiliations](#)

**Publication:** Communications of the ACM • June 1981 • <https://doi.org/10.1145/358669.358692>

11,348  23,642

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Communications of the ACM

Volume 24, Issue 6

June 1981

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[Abstract](#)

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### Abstract

A new paradigm, Random Sample Consensus (RANSAC), for fitting a model to experimental data is introduced. RANSAC is capable of interpreting/smoothing data containing a significant percentage of gross errors, and is thus ideally suited for applications in automated image analysis where interpretation is based on the data provided by error-prone feature detectors. A major portion of this paper describes the application of RANSAC to the Location Determination Problem (LDP): Given an image depicting a set of landmarks with known locations, determine that point in space from which the image was obtained. In response to a RANSAC requirement, new results are derived on the minimum number of landmarks needed to obtain a solution, and algorithms are presented for computing these minimum-landmark solutions in closed form. These results provide the basis for an automatic system that can





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# with applications to image analysis and automated cartography



Authors:  [Martin A. Fischler](#),  [Robert C. Bolles](#) [Authors Info & Affiliations](#)






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title = {Random Sample Consensus: A Paradigm for Model Fitting with Applications to Image Analysis and Automated Cartography},
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issue_date = {June 1981},
publisher = {Association for Computing Machinery},
address = {New York, NY, USA},
volume = {24},
number = {6},
issn = {0001-0782},
url = {https://doi.org/10.1145/358669.358692},
doi = {10.1145/358669.358692}
    
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## Automatically Scheduling Halide Image Processing Pipelines

Ravi Teja Mullapudi\*   Andrew Adams<sup>‡</sup>   Dillon Sharlet<sup>‡</sup>   Jonathan Ragan-Kelley<sup>†</sup>   Kayvon Fatahalian\*

\*Carnegie Mellon University

<sup>‡</sup>Google

<sup>†</sup>Stanford University

### Abstract

The Halide image processing language has proven to be an effective system for authoring high-performance image processing code. Halide programmers need only provide a high-level strategy for mapping an image processing pipeline to a parallel machine (a *schedule*), and the Halide compiler carries out the mechanical task of generating platform-specific code that implements the schedule. Unfortunately, designing high-performance schedules for complex image processing pipelines requires substantial knowledge of modern hardware architecture and code-optimization techniques. In this paper we provide an algorithm for automatically generating high-performance schedules for Halide programs. Our solution extends the function bounds analysis already present in the Halide compiler to automatically perform locality and parallelism-enhancing global program transformations typical of those employed by expert Halide developers. The algorithm does not require costly (and often impractical) auto-tuning, and, in seconds, generates schedules for a broad set of image processing benchmarks that are performance-competitive with, and often better than, schedules manually authored by expert Halide developers on server and mobile CPUs, as well as GPUs.

**Keywords:** image processing, optimizing compilers, Halide

**Concepts:** •Computing methodologies → Graphics systems and interfaces;

algorithm's execution on a machine (called a *schedule*). The Halide compiler then handles the tedious, mechanical task of generating platform-specific code that implements the schedule (e.g., spawning threads, managing buffers, generating SIMD instructions).

Although Halide provides high-level abstractions for expressing schedules, *designing* schedules that perform well on modern hardware is hard; it requires expertise in modern optimization techniques and hardware architectures. For example, around 70 software engineers at Google currently write image processing algorithms in Halide, but they rely on a much smaller cadre of Halide scheduling experts to produce the most efficient implementations. Further, production image processing pipelines are long and complex, and are difficult to schedule even for the best Halide programmers. Arriving at a good schedule remains a laborious, iterative process of schedule tweaking and performance measurement. Also, in large production pipelines, software engineering considerations (e.g., modularity, code reuse) may preclude experts from having the global program knowledge needed to create optimal schedules.

In this paper we address this problem by providing an algorithm for automatically generating high-performance schedules for Halide programs. Our approach is to leverage the function bounds analysis already present in the Halide compiler to automatically perform locality enhancing global program transformations similar to those employed by expert Halide developers. The algorithm does not require costly (and often impractical) auto-tuning, and, in seconds,

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