Creating Meaningful Benchmarks: Lessons Learned

Jeff Bier, President
Berkeley Design Technology, Inc.
Walnut Creek, California USA
+1 (925) 954-1411

info@BDTI.com
http://www.BDTI.com

Copyright © 2014 Berkeley Design Technology, Inc.
About BDTI

BDTI provides:

• Best-in-class product development engineering services
  • Emphasis on optimization for performance, cost and power
• Expert, objective benchmarking and evaluation
  • For technology selection, feasibility studies, competitive analysis and proof points
• Licensable benchmark suites and certification services

Focused on:

• Algorithm-intensive applications: vision, video, audio, wireless
• Embedded processors, tools and techniques:
  • CPU, GPU, DSP, FPGA, many-core, etc.

“These guys make a living telling the truth.”

– Kevin Morris, Editor in Chief, FPGA Journal
Objectives for a New Benchmark

• Results must exist—soon
• Results must be relevant
• Results must be accurate
• Results must be credible
• Results must reach the target audience(s)…
• …in a readily understandable and actionable form
Benchmark Design Trade-offs

Development Effort, Implementation Effort

Breadth of Applicability

Accuracy, Relevance

Ease of Use of Results

Accuracy, Relevance
Diminishing Returns

Accuracy, Relevance

Development Effort, Implementation Effort
Long-term Embedded/Mobile Trends

- Application, system, software capability and complexity increase
- System functionality becomes more heterogeneous
- Processors become more complex and heterogeneous
- Proprietary algorithms are key differentiators
- Programming approaches, languages, tools are changing more rapidly

→ Collectively, these trends create enormous challenges for benchmarking
Addressing Complexity and Heterogeneity

As systems, applications and processors become more complex, it becomes difficult to approximate the performance of the whole from that of the parts.

Kernel benchmarks are of diminishing value for evaluating systems.

The natural solution is to benchmark at the system level, using full applications.

This approach has its own challenges:

- Creating realistic synthetic full-application benchmarks is very costly.
- Access to the real application code is often impossible.
- Porting and optimizing the real application code to multiple system architectures is very costly.
Certimo: User Experience Ratings For Smart Devices
A Unique Approach

**Consumer Research**
- User research data
- Consumer usage patterns
- By device type
- By region

**Benchmarking**
- Performance, battery and display
- Lab-run tests ~3 days
- Ratings weighted by UX data
- All ratings certified by BDTI

**Consumers**
- Educate consumers on UX
- Deliver UX ratings at scale
- Analytics via mobile app

© 2014 BDTI

ANALYSIS • ADVICE • ENGINEERING
FOR EMBEDDED PROCESSING TECHNOLOGY
A Word of Caution Regarding Open Source Benchmarks

The benefits of creating open-source benchmarks are obvious. The drawbacks are sometimes less obvious:

- Fragmentation can encourage bogus comparisons.
- Proliferation of unverified erroneous results means that errors and cheating are much more likely to go undetected.
- → Utility and credibility suffers.
Metric Neglect

Great care goes into the choice of benchmark functionality

Often, insufficient thought goes into the choice of metrics

Even seemingly simple metrics can be complex

  • E.g., what is “time”? Throughput? Latency? Average? Peak?

Increasingly, the metrics that matter are complicated. E.g.,

  • An application requires a certain level of performance; more performance is not better – and may actually be worse

  • Output quality is often a complex concept
    • E.g., smoothness of user interface response
    • E.g., perceived quality of audio and video
Implementation and Optimization Methodology

Specifying the allowable implementation and optimization paths for a benchmark is as important as specifying the functionality.

“Run This Code”

High-level Functional Spec: Carte Blanche on Implementation (E.g., Free Substitution of Algorithms No Limits on Latency)
Key Application Domain: Computer Vision ➔ Embedded Vision

*Computer vision*: systems that **extract meaning** from visual inputs.

Computer vision has been an active research field for decades, with limited commercial applications.

*Embedded vision*: the **practical, widely deployable** evolution of computer vision

- Applications: industrial, automotive, medical, defense, retail, gaming, consumer electronics, security, education, …
- Embedded systems, mobile devices, PCs and the cloud
What Does Embedded Vision Enable?
Empowering Product Creators to Harness Embedded Vision

The Embedded Vision Alliance ([www.Embedded-Vision.com](http://www.Embedded-Vision.com)) is a partnership of leading embedded vision technology and services suppliers.

Mission: Inspire and empower product creators to incorporate visual intelligence into their products.

The Alliance provides low-cost, high-quality technical educational resources for engineers:

- The Alliance website offers in-depth tutorial articles, video “chalk talks,” code examples, tools and discussion forums.
- The *Embedded Vision Insights* newsletter delivers news, Alliance updates and new resources.
- Embedded Vision Summit conferences provide classroom and hands-on learning, exciting demos and keynotes, and unique networking opportunities.
Thank You!

For More Information:

- BDTI development, benchmarking and analysis services, and licensable benchmark suites: [www.BDTI.com](http://www.BDTI.com)

- Certimo mobile device rating system: [www.Certimo.org](http://www.Certimo.org)

- Embedded Vision Alliance: [www.embedded-vision.com](http://www.embedded-vision.com)

- Or email us at info@BDTI.com