Havok: Optimize Game Code for Better Real-Time Physics

Gamers are constantly looking for the next hot playing experience. Game developers feed this hunger by perfecting game realism, animation, and interactivity. This frequently includes optimizing their newest games for the latest game-playing platforms. To keep raising the bar, many top game developers and publishers use products from Havok, one of the gaming industry’s leading independent providers of physics and character animation middleware. Its leading physics engine is one of the most widely used technologies for developing state-of-the-art games such as F.E.A.R*, Half Life 2*, Age of Empires III*, Company of Heroes*, Max Payne 2*, Destroy All Humans 2*, Over the Hedge*, Auto Assault*, and Oblivion*.

Havok’s dedication to continuously innovating, enhancing, and optimizing its technology for new platforms has made it a first-choice for renowned publishers like Sony, Microsoft, EA, Ubisoft, and Activision.

“Havok is an extremely important software partner for us. Their innovative, compelling Havok Physics* engine is a perfect showcase of today’s multi-core processors capabilities. Moreover, with our joint forces, we can together shape the exciting future of gaming.”

–Marco Vettorello, Software Enabling Manager
Intel® Software Group
To be competitive, today’s game worlds require realistic animations, authentic behaviors, and highly believable characters. Accomplishing such realism requires superior gameplay physics simulations. Gameplay physics affects how a game is played from moment-to-moment, and is generally computed on a computer’s processor. Physical changes that you cause in the game or that happen to you or around you—like knocking over a box, and then climbing up on it—change what you may want to do in each instant of gameplay. To maintain the realism, all these changes have to occur smoothly with no detectible latency. For this to happen, the close proximity between physics, game logic, and memory generally demands that these systems execute together on a computer’s processor.

A limiting factor in the past was hardware power. This is rapidly changing with the advent of multi-core processors. Combined with graphics processing unit (GPU) graphics, multi-core processor architectures have the potential to enable fully simulated game characters and their moment-to-moment actions in completely interactive and destructible 3-D worlds. Havok has introduced HydraCore* technology in its physics system and other products to take advantage of these architectures now and in the future.

**OPENING UP THE POWER OF MULTI-CORE WITH HAVOK HYDRACORE***

Fully exploiting multi-core power requires the effective use of multi-threading. But parallelizing real-time physics is an extremely tough job—there are hundreds of ways and speeds at which a player might choose to move a character or set an action into motion, and hundreds of ways that motion or action might turn out.

HydraCore removes some of this complexity by enabling a game developer to flexibly assign and remove threads from computationally heavy tasks, thus boosting the overall game performance and physics quality. To harvest the full power and scalability of multi-core hardware, this adaptive technology splits up the workload required for each interval of gameplay into a list of jobs that can be executed as needed. This new approach to physics calculation requires fundamental rewriting of the software code to enable complex simulation methods to run across multiple processors simultaneously.

To fine tune HydraCore for multi-core, Havok—as an Intel® Software Partner—was able to take advantage of both early access to dual- and quad-core processors and the expertise of Intel software engineers. By getting detailed feedback on the software code profile and how the various physics workloads scaled as they

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**SUCCESS STORY**

To enable game developers to harness all the power of the latest multi-core hardware, Havok recently teamed up with an Intel® Software group in an Intel® Software Partner Program Gaming Initiative to deliver cutting-edge game development tools. First up was the fine tuning of Havok HydraCore* technology, a component designed for accelerating Havok-powered games by taking advantage of Multi-Core Intel® processor-based platforms. Developed by Havok, HydraCore is now included in all its products to help game developers deliver unparalleled physical gameplay experiences and dynamically responsive character animation on multi-core platforms.

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Consider the complexity of all the real-time body movements put in motion each second by a player executing a tackle with a character.
increased the number of available processors, Havok could target optimization at the most appropriate places. Using the Intel® VTune™ Performance Analyzer, Havok has been able to significantly enhance this innovative software through detailed knowledge of how their algorithms map to the targeted hardware, allowing them to optimize the memory usage and instruction mix, as well as reduce the amount of synchronization overhead associated with distributing the workload across multiple processors. In addition, Intel® Threading Tools provided important information on how the workload was balanced across the available resources.

To demonstrate the significant scalability improvement of its optimized software technology, Havok simulated a 3-D scenario with 200 rag dolls and captured the time taken to process the physics calculations when using a single thread compared to two threads on an Intel® Core™2 Extreme processor. The result: Running on a Dual-Core Intel Core2 Extreme processor, Havok Physics* (a product that uses HydraCore technology) was 1.7 times faster than on the single-core system.2

THE INNOVATION NEVER STOPS

No one in the game industry can afford to stand still. That includes companies like Havok that provide the software community with the innovative tools they need to give their games the best performance on the latest hardware.

With HydraCore technology, Havok continues its tradition of providing leading-edge technologies for the gaming industry. Havok's dedication to innovation and excellence continues to earn the company prestigious awards, including most recently the Best Innovation award at Computex, listing as a Red Herring Top 100 company, and recognition as an OnHollywood* 100 winner.

Both Havok and Intel are committed to continuing to team up on powerful enabling technologies and software to shape the future of gaming experiences. Optimizing Havok products for next-generation multi-core Intel® processors is just one example. More work is underway. By using Havok products with HydraCore, game developers can significantly accelerate their production cycles and take advantage of Intel's leadership in multi-core processor architecture to give gamers more compelling, immersive game experiences and effects.

Multi-core processor architectures have the potential to provide more fully simulated game characters and moment-to-moment actions in completely interactive worlds, such as this character running through steaming vents.

“Havok created HydraCore* technology to allow us to optimize for a multi-threading environment. Efficient threading unleashes the power of the Intel® Core™2 Duo processor and the Intel Core2 Extreme quad-core processor, allowing increasingly scalable and realistic physical effects and credible character animation.”

–David Coghlan
Vice President, Development, Havok

ABOUT HAVOK

Havok is a premier provider of interactive software and services, offering world-leading expertise in physics, animation, and tools for digital media creators in the game and movie industries. Havok’s modular suite of tools enables companies to achieve new standards of realism and interactivity. For more information, visit www.havok.com.

1 Havok internal research data
2 Performance tests and ratings are measured using specific computer systems and/or components and reflect the approximate performance of Intel products as measured by those tests. Any difference in system hardware or software design or configuration may affect actual performance. Buyers should consult other sources of information to evaluate the performance of systems or components they are considering purchasing. For more information on performance tests and on the performance of Intel products, reference www.intel.com/performance/index.htm and any Intel source materials such as performance briefs or white papers.
Intel® Software

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Explore these resources for more information on topics covered in the articles:

- Havok: Optimize Game Code for Better Real-Time Physics
  - Havok HydraCore*: www.havok.com/content/view/25/46/
  - Threading Basics for Games: www.intel.com/software/threadinggames
  - Multi-Threaded Rendering and Physics Simulation: www.intel.com/software/physicsimulator

- Simplicity Drives Innovation: Intel® Virtualization Technology Opens New Era in Server Virtualization
  - Intel® Virtualization Technology: www.intel.com/technology/virtualization/index.htm
  - Virtual Iron: www.virtualiron.com

- Threading Basics for Games: www.intel.com/software/threadinggames
  - Multi-Threaded Rendering and Physics Simulation: www.intel.com/software/physicsimulator

- Multi-Threaded Rendering and Physics Simulation: www.intel.com/software/physicsimulator

- Engaging with the Software Community—Fully Parallel Game Universe
  - For details on game threading training: www.intel.com/software/gamethreadtraining
  - 2007 Intel Game Demo Contest: www.intel.com/software/gamecontest
  - Intel® Software Network Game Developer Center: www.intel.com/software/games

- Innovative Outreach Builds Momentum for Multi-Core Development Globally—Part One
  - Multi-Core Developer Community – Intel® Software Network: www.intel.com/software/mcdeveloper
  - TopCoder: www.intel.com/software/topcoder
  - Intel® Software Network Blogs: www.intel.com/software/ISNblogs

- Convergence Rules: Consumer Electronics Show 2007
  - About the International CES: www.cesweb.org/about_ces/

- Forge a Competitive Advantage from Planning to Sales: Work with the Intel® Software Partner Program
  - If you're not already enrolled in the Intel Software Partner Program and want to find out more, visit: www.intel.com/partner

- Microsoft – www.microsoft.com/windowsserversystem/virtualization
- Novell – www.novell.com/intel
- Red Hat – https://accelerate.108.redhat.com

- Virtual Solutions from:
  - VMware – www.virtualizeasap.com

- Virtual Solutions from:
  - Virtual Iron: www.virtualiron.com/products/resource_center.cfm

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  - Multi-Core Developer Community – Intel® Software Network: www.intel.com/software/mcdeveloper
  - TopCoder: www.intel.com/software/topcoder

- Intel® Software Network Blogs: www.intel.com/software/ISNblogs

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  - TopCoder: www.intel.com/software/topcoder

- Intel® Software Network Blogs: www.intel.com/software/ISNblogs

- Learn more about Intel® Solution Services: www.intel.com/go/intelsolutionservices

- Sign up for the Intel Software Partner Program, available to software companies: www.intel.com/partner

- Find out more about Intel® Software Network: www.intel.com/software

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