

Redefining Human Kinematics with Mu Sigma and Intel

Mu Sigma's HMT system, powered by Intel® hardware and software solutions, offers high accuracy, real-time tracking, and actionable insights into human kinematics.

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Executive Summary

As the demand for advanced motion sensing technology continues to rise, Human Motion Tracking (HMT) emerges as a pivotal solution for enhancing efficiency, safety, and user experience across a wide array of industries.

Through the utilization of advanced sensors, algorithms, and robust data analytics, Human Motion Tracking (HMT) system facilitates real-time monitoring, analysis, and comprehension of human movements. This capability provides invaluable insights that optimize performance, mitigate risks, and foster innovation. Spanning across sectors such as healthcare, sports, entertainment, and manufacturing, HMT holds immense potential to revolutionize workflows, empower individuals, and elevate the quality of human-machine interactions.

Mu Sigma's HMT system represents a state-of-the-art solution, driven by cutting-edge Intel's technology, computer vision, and motion-sensing advancements. This innovative system delivers unparalleled accuracy, enabling real-time tracking and providing actionable insights into human kinematics.

Leveraging advanced algorithms and sophisticated hardware, the Mu Sigma's HMT system ensures precise tracking of human movement, facilitating informed decision-making and optimizing performance across various applications. With its high accuracy and real-time capabilities, this system redefines the standards for motion tracking, offering benefits that cut across industries.

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“By combining Intel's cutting-edge AI hardware and Mu Sigma's deep analytics expertise, we are unlocking new frontiers in computer vision and motion tracking. This partnership represents a significant leap forward in enabling highly accurate and real-time human motion tracking capabilities. From athletic performance analysis to healthcare rehabilitation, our Human Motion Tracker solution will empower businesses and organizations to extract invaluable insights from human movement data, driving innovation and enhancing experiences across multiple sectors.”

Amaresh Kalavara
Senior Apprentice Leader,
Mu Sigma

The Need for Seamless Human Motion Tracking

Mu Sigma's HMT system, underpinned by image recognition technology, sets a new benchmark in the landscape of human movement analysis and interpretation from visual data. This intelligent system harnesses the power of deep learning techniques to detect and track a plethora of human gestures, poses, and actions in real time with remarkable accuracy. Its applications are broad and versatile, spanning across diverse fields such as sports biomechanics, healthcare, security surveillance, and human-computer interaction.

At its core, the HMT system operates by processing video or image data to pinpoint key positions on the human body, such as joints and limbs. It meticulously tracks their respective positions and movements over time, creating a detailed record of human motion. The HMT system paves the way for an array of powerful applications. Gesture-based interfaces can be developed, offering users a more interactive and immersive experience. Fitness activity can be monitored with precision, providing comprehensive feedback on performance and progress. In-depth analysis of athletic performance becomes possible, allowing for personalized training programs that can enhance an athlete's performance and prevent injuries.

Beyond its practical applications, the HMT system stands out for its ability to provide valuable insights into human kinetics and behavior. These insights can drive innovation across various domains, from improving athletic training methodologies in sports biomechanics to advancing patient rehabilitation programs in healthcare. Furthermore, the system fosters a deeper understanding of human motion dynamics. This knowledge can be leveraged to refine existing technologies and develop new solutions in areas such as security surveillance and human-computer interaction. By combining sophisticated image recognition and deep learning techniques, it provides an innovative solution for analyzing and interpreting human motion, ultimately revolutionizing our understanding of human kinetics.

Enabling Innovative Use Cases

HMT technology represents a transformative solution to myriad challenges spanning various industries. Furthermore, the adoption of HMT technology enables a wide range of use cases that include:

- **Sports Biomechanics:** In sports training and rehabilitation, motion trackers help analyze athletes' movements to improve technique, prevent injuries, and optimize performance. Coaches and trainers can use the data to provide personalized feedback and develop tailored training programs.
- **Healthcare and Rehabilitation:** Motion trackers are used in physical therapy and rehabilitation to monitor patients' movements and progress. They enable therapists to track range of motion, gait patterns, and adherence to prescribed exercises, facilitating more effective treatment and recovery.

- **Virtual Reality and Gaming:** Motion trackers are integrated into virtual reality (VR) systems and gaming platforms to provide immersive experiences and enable gesture-based interaction. Users can control virtual avatars or characters through natural movements, enhancing realism and engagement in VR environments and games.
- **Security and Surveillance:** Motion trackers are employed in security surveillance systems to detect and track human movements in monitored areas. They help identify suspicious activities, monitor crowd behavior, and enhance situational awareness in public spaces, airports, and other security-sensitive locations.
- **Human-Computer Interaction:** Motion trackers enable hands-free interaction with computers, smartphones, and other electronic devices through gestures and movements. This technology is used in applications such as gesture-controlled interfaces, augmented reality (AR) applications, and interactive displays, enhancing user experience and accessibility.
- **Industrial Automation:** In manufacturing and industrial settings, motion trackers are utilized for human-machine interaction and safety monitoring. They enable robots and machinery to detect and respond to human presence, ensuring safe and efficient operation in collaborative work environments.
- **Ergonomics and Workplace Safety:** Motion trackers help assess ergonomic conditions and identify potential workplace hazards by analyzing workers' movements and postures. This information is used to design ergonomic workstations, prevent musculoskeletal injuries, and promote a healthier and safer work environment.
- **Education and Research:** Motion trackers are valuable tools for studying human movement and behavior in educational and research settings. Researchers use them to investigate biomechanics, motor control, and human kinetics, advancing our understanding of human physiology and performance.



The Right Technology Integration for Seamless Optimization

Intel's hardware and software platform plays a key role in the optimization of Mu Sigma's HMT solution. Intel's hardware platforms, including CPUs, GPUs, FPGAs, and VPUs, are tailored and optimized for performing complex deep learning tasks, such as image recognition, that are vital in motion tracking. Coupled with the Intel software stack, including tools like the Intel® Distribution of OpenVINO™ toolkit, the HMT system can effectively optimize, deploy, and execute models across various Intel hardware platforms. This not only ensures efficient execution but also significantly enhances the speed and performance of the HMT system.

Mu Sigma's HMT is able to deliver superior performance, accuracy, and efficiency in tracking human motion across diverse applications thanks to the seamless integration of Intel's hardware and software platforms that include:

- **Hardware Optimization:** Intel's hardware platforms, including CPUs, GPUs, FPGAs, and VPUs, are tailored for deep learning tasks such as image recognition. These platforms support specialized instructions and architectures specifically designed to accelerate the execution of neural network operations, thereby enhancing the efficiency and speed of the HMT system.
- **Acceleration with OpenVINO™:** The ResNet model, a Convolutional Neural Network (CNN) architecture integral for image recognition, is optimized for Intel's hardware platforms using the Intel® Distribution of OpenVINO™ toolkit. It provides a set of tools and libraries that facilitate model optimization and deployment across various Intel hardware platforms, ensuring the efficient execution of the ResNet model.



- **Utilization of Intel® Architecture:** The specific hardware configuration determines which Intel® architecture the ResNet model will leverage. Options include Intel® Xeon® Scalable processors, Intel® Core™ processors, and Intel® Iris® Xe graphics. Each architecture offers unique levels of performance and scalability, catering to diverse image recognition tasks.
- **Model Optimization:** The ResNet model is optimized using the OpenVINO™ toolkit to enhance performance and efficiency on Intel hardware. This optimization process involves quantization, pruning, and other techniques to reduce the computational complexity of the model while maintaining accuracy.
- **Inference Engine:** OpenVINO™ provides an inference engine that enables the deployment and efficient execution of the optimized ResNet model on Intel hardware. The inference engine capitalizes on hardware acceleration features to boost inference speed and throughput.
- **Integration with Application Code:** The optimized ResNet model is converted into OpenVINO™ IR format and prepared for inference for various image recognition tasks. This integration ensures a seamless interaction between the model, hardware, and software components, ultimately enabling real-time image recognition capabilities.

Enabling High-impact Benefits

Intel's hardware and software platforms offer a multitude of benefits that make it an ideal choice for Mu Sigma's HMT system. Foremost among these benefits is performance. Intel® processors are renowned for their high performance and reliability. They are designed to handle demanding tasks such as image processing and deep learning, making them a suitable choice for HMT applications that require robust computational power. Additionally, Intel continuously optimizes its hardware and software, ensuring the delivery of superior performance and efficiency.

Intel's hardware also offers wide compatibility with various software frameworks and libraries, providing SDKs and APIs that facilitate smoother integrations. This wide-ranging compatibility allows for a high degree of flexibility and interoperability in hardware-software integrations. Scalability is another key advantage of Intel's hardware.

In terms of support and resources, Intel provides extensive documentation, developer resources, and advanced debugging capabilities. These resources are instrumental in helping Mu Sigma to optimize HMT applications for Intel hardware, ensuring smooth integration and efficient performance. The use of Intel's hardware helps Mu Sigma in meeting the needs of an end-to-end optimized and integrated platform, providing a blend of high performance, compatibility, scalability, and comprehensive support.

Customer Success Story

Enhancing safety and efficiency in warehouse operations for a leading home improvement retailer

Challenge:

A leading home improvement retailer with a vast network of warehouses and stores nationwide prioritizes employee safety and operational efficiency. However, manual inspections and safety protocols proved inadequate in effectively monitoring and improving warehouse safety. Identifying potential hazards or unsafe behaviors in real time was challenging, leading to concerns regarding employee safety and operational inefficiencies.

Solution:

To address these challenges, the retailer implemented Mu Sigma’s HMT system in its warehouses. Leveraging advanced motion-sensing technology and computer vision algorithms, the HMT system provided real-time monitoring of employee movements. By analyzing human motion patterns, the system could swiftly detect safety violations and potential hazards within the warehouse environment, enabling the company to take immediate action to mitigate potential hazards and risks.

Impact:

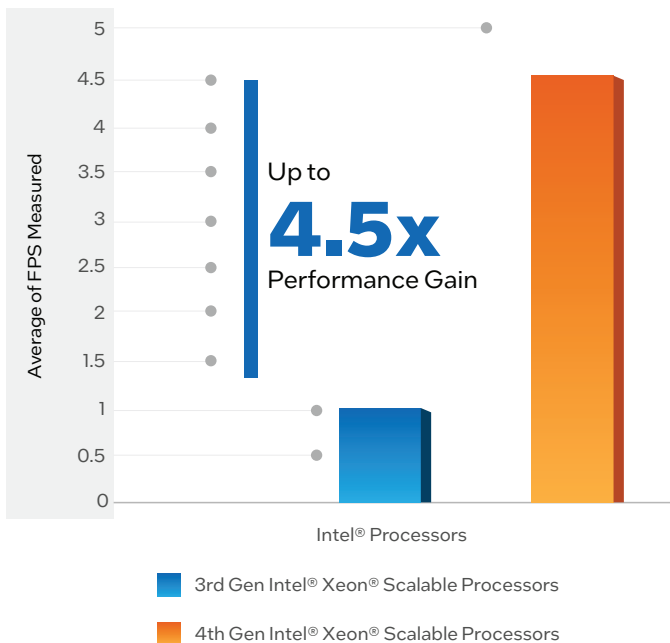
The implementation of the HMT system yielded significant benefits for the home improvement retailer. By swiftly detecting safety violations and potential hazards in real time, the company improved overall warehouse safety and mitigated the risk of workplace accidents and leading to reduced instances of injuries and accidents. Additionally, the HMT system enhanced operational efficiency by streamlining safety monitoring processes and reducing the need for manual inspections. This not only saved time but also helped in optimizing warehouse operations for increased productivity and effectiveness.

Gaining the Performance Advantage with Intel

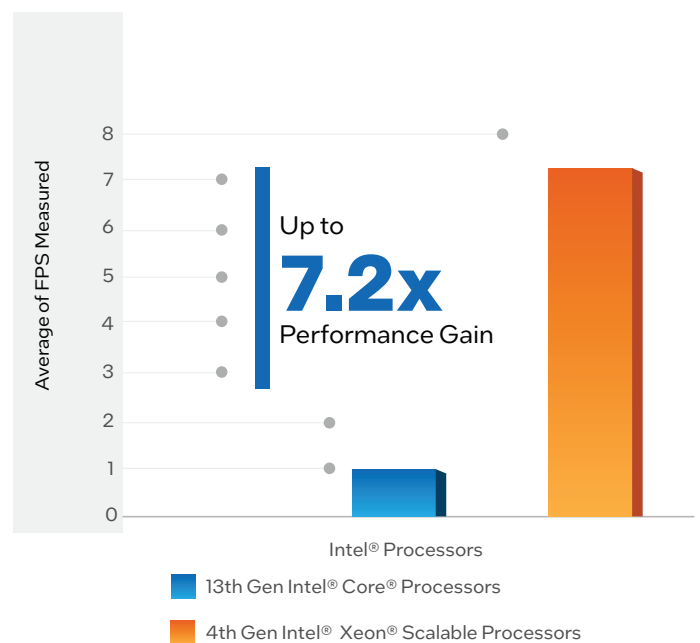
For HMT that makes use of advanced computer vision and motion-sensing technology, performance is a key driving factor for achieving seamless results. See how Intel® CPUs and GPUs provided the power Mu Sigma needed to optimize and accelerate HMT performance.¹

CPU Performance for HMT Workloads

3rd Gen Intel® Xeon® Scalable Processors vs 4th Gen Intel® Xeon® Scalable Processors

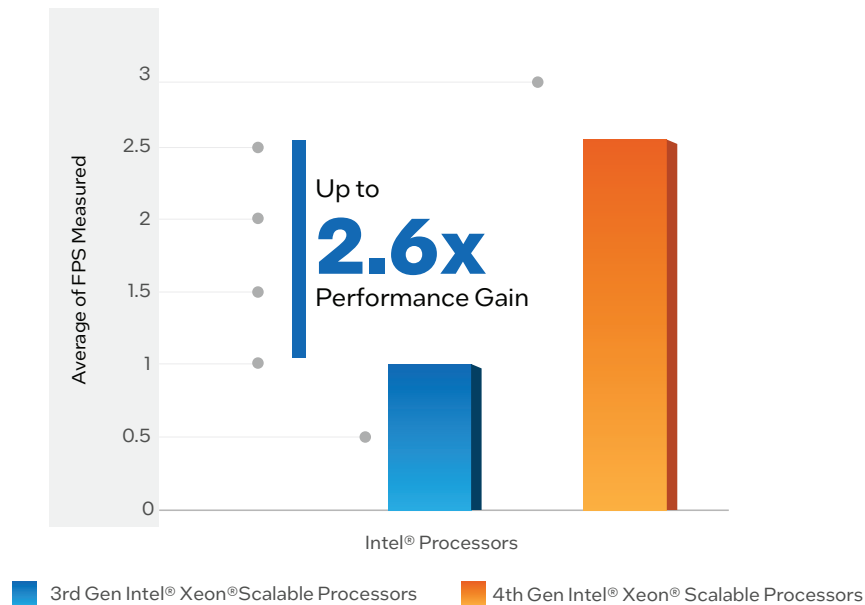


13th Gen Intel® Core™ Processors vs 4th Gen Intel® Xeon® Scalable Processors



GPU Accelerated Performance for HMT Workloads

4th Gen Intel® Xeon® Scalable Processors vs 3rd Gen Intel® Xeon® Scalable Processors



Conclusion

Through rigorous benchmarking assessments, Mu Sigma analysis revealed that the latest Intel's hardware iterations, comprising 4th Gen Intel® Xeon® processors, Intel® Data Center Flex GPU, and Intel® Arc™ graphics surpassed earlier generations in terms of performance metrics. This enhanced performance capability proved instrumental in meeting the demanding requirements of Mu Sigma's HMT system. The exceptional performance exhibited by Intel's hardware not only met but exceeded the performance benchmarks set forth by Mu Sigma, underscoring Intel's pivotal role in driving innovation and enabling cutting-edge solutions in the human motion tracking technology landscape.

Spotlight on Mu Sigma

Mu Sigma is the world's largest pure-play big data analytics and decision sciences company. Through the Art of Problem-Solving, Mu Sigma strives to scale and systematize better decision-making through business intelligence services. Mu Sigma works across the entire decision support ecosystem (data sciences, data engineering, and decision sciences) with Fortune 1000 companies worldwide, including 140+ Fortune 500 companies.



¹Internal benchmarking results from tests conducted by Mu Sigma.

Performance varies by use, configuration and other factors. Learn more at <https://intel.com/benchmarks>

Performance results are based on testing as of dates shown in configurations and may not reflect all publicly available updates. See backup for configuration details.

No product or component can be absolutely secure.

Your costs and results may vary.

Intel does not control or audit third-party data. You should consult other sources to evaluate accuracy.

Intel technologies may require enabled hardware, software or service activation.

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