ENG

WEIR
MOTION METRICS

We **inspire**
a new generation
of safe, sustainable,
and intelligent mining.

WEIR *MOTION METRICS*

Weir Motion Metrics is a Canadian technology development and commercialization company with offices around the world.

ShovelMetrics™   **Loader**Metrics™   **Truck**Metrics™   **Belt**Metrics™   **Porta**Metrics™ Gen2

Technologies

Machine Vision

We build rugged solutions to withstand the harshest environments.

Our machine vision systems are engineered to military standards to survive extreme shock, vibration, temperatures, altitude, rain, and snow. We offer visible range, thermal, and 3D (stereo) imaging systems that meet tough technical requirements such as low-light and sub-zero temperature conditions.

Artificial Intelligence

Our machine learning algorithms are trained on vast data sets to provide unparalleled accuracy and speed.

We have operations on four continents and clients on six. In the world of artificial intelligence, that means that we can train our prediction models on a broad range of images, videos, and other sensor data to ensure that our smart systems can handle any operating environment imaginable.

Cloud Computing

We provide data analysis products that are as intuitive as they are powerful.

Our secure servers and centralized data analysis platform provide mine management with actionable data, custom reports, and dashboards that can be accessed from anywhere in the world. We prioritize the customer experience, deploying regular software updates and customized training from our regional offices.

Patent Information

Motion Metrics products are protected by:

AU-2016374520, CA-2972183, RU-2694021, US-10783610, PE-9795, RU-2713684, US-10339667, CA-2863709, GB-2536271, US-9418309, CA-2781349, US-9030332, CA-2742335, US-8843279, CA-2683357, US-8405721, CA-2546758, US-8411930, CL-47110, CA-2888584, CA-2655002, US-7878254, and other pending patents.

"My role is to develop innovative products that create real value for our customers. Our machine vision products bring the Industrial Internet of Things (IIoT) to mines worldwide."

Enoch Chow
Director of Product Development

"Drawing on extensive industry experience in algorithm development and machine vision, my department ensures that our smart solutions deliver timely, accurate, and actionable results under any environmental conditions."

Saman Nouranian, PhD
Director of AI Research

"My team remotely monitors all installed Motion Metrics systems to ensure our products are functioning as expected and alert customers proactively to any maintenance concerns."

Kelly Rao
Support and Data Analyst

ShovelMetrics™ Gen3

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Introducing the next generation
in G.E.T. and Shovel Monitoring

ShovelMetrics Gen 3 uses artificial intelligence and computer vision to provide industry-leading bucket G.E.T., rock monitoring, and shovel monitoring. With industry-leading 3D imaging technology and support for all shovels and excavators, backhoes, and shovels. Our flagship shovel monitoring solution is a fully managed service that includes accurate and reliable missing tooth detection and lip shroud monitoring. These features mitigate the risk of crusher obstructions in order to safeguard your employees and prevent hundreds of thousands of dollars in lost production. ShovelMetrics Gen 3 pays for itself by increasing productivity and reducing operational downtime.

> *"Previously, mine personnel had to enter the primary crusher to remove a missing tooth. With ShovelMetrics, we remove our people from the line of fire and maintain operational continuity."*
>
> Gustavo Córdova, **Mine Manager, Codelco Gabriela Mistral Mine**

Features

Missing Tooth Detection
Mitigate the risk of dangerous and costly crusher obstructions by alerting shovel operators to missing teeth.

Particle Size Analysis
Optimize drill and blast parameters with real-time particle size data.

Payload Monitoring
Maximize productivity with bucket-by-bucket payload monitoring.

Tooth Wear Monitoring
Optimize tooth change-out intervals by monitoring wear.

Boulder Detection
Improve blast efficiency while minimizing crusher downtime and reduce rock-breaker usage by diverting oversized material.

Blind Spot Reduction
Reduce the likelihood of equipment collisions with real-time surveillance views.

Lip Shroud Monitoring
The world's first solution to identify missing bucket lip shrouds in real-time before they reach the crusher.

Payload Monitoring
Maximize productivity and ensure truck compliance with bucket-by-bucket payload monitoring.
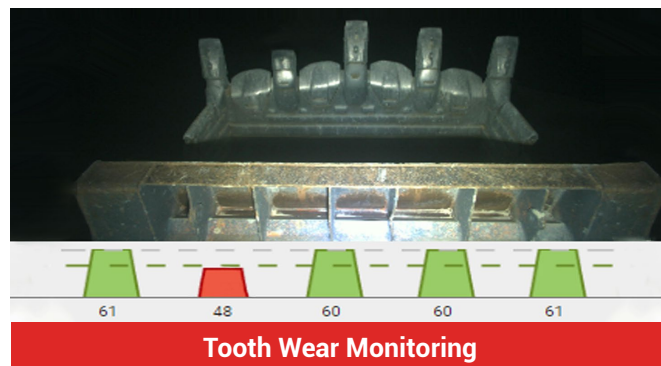
Video Recording
3 days of continuous recording from the Bucket Camera and Blind Spot Reduction cameras are stored for each system.
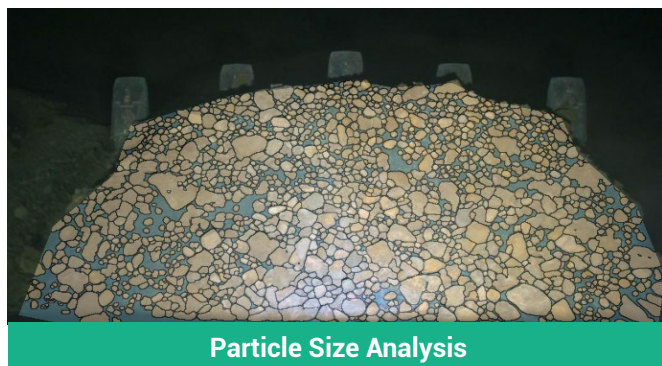
Particle Size Analysis

Tooth Wear Monitoring

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ShovelMetrics™
Gen **3**

Thermal Edition
For northern regions and sticky digging materials

To detect missing teeth, the ShovelMetrics camera needs a clear view of the shovel or excavator bucket. This can be difficult at mines in northern regions, which receive very little sunlight during the winter, or at mines where sticky material can obscure the teeth. To overcome these challenges, we developed a thermal version of ShovelMetrics that provides accurate missing tooth detection under the harshest environmental conditions

– even in total darkness.

How a Chilean Copper Mine Used ShovelMetrics to Save $6.5M

After successfully trialling the system, a large open-pit copper mine near Santiago, Chile installed ShovelMetrics to mitigate the risk of missing shovel teeth. The system exceeded key performance indicators set by the mine and helped the mine avoid an annual production loss equivalent to about USD $6.5M.

Metrics**Manager**™ Pro

Like all Motion Metrics products, ShovelMetrics interfaces with our centralized data analysis platform, MetricsManager Pro. Users with authorized credentials can receive automated SMS and email event notifications, in-depth performance reports, equipment activity logs, and particle size data from anywhere. Motion Metrics recognizes the importance of interoperability and will work with other vendors to ensure our solutions interface with your existing software.

LoaderMetrics™

Mitigate production loss
caused by tooth breakage.

LoaderMetrics uses artificial intelligence and rugged thermal imaging to provide accurate missing tooth detection for all loader types. Our proprietary lens cleaning system, which is deployed either remotely or by the operator, ensures accurate performance under the harshest environmental conditions. We build our hardware in Canada to meet or exceed military standards for temperature, shock, vibration, and dust.

"The average crusher obstruction costs our operation about USD $300K in production loss. Since installing LoaderMetrics, we have experienced zero crusher downtime."
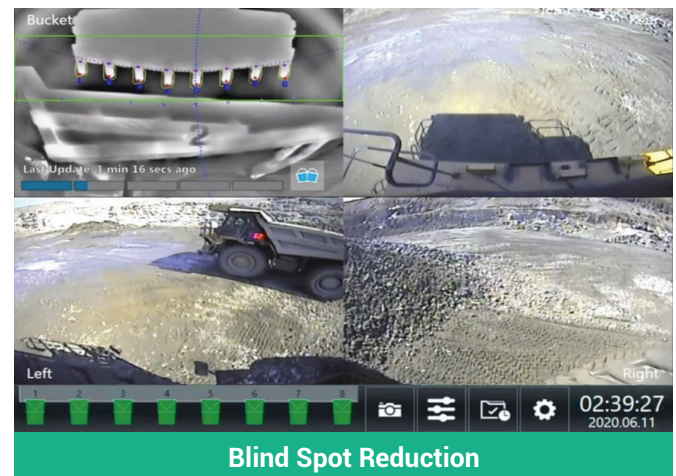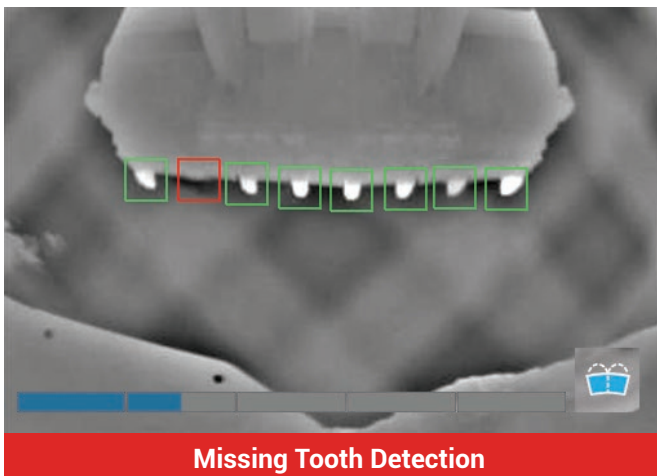
Features

Missing Tooth Detection

Prevent crusher obstructions and conveyor belt damage by monitoring loader teeth.

Blind Spot Reduction

Prevent equipment collisions with real-time surveillance views.

Missing Tooth Detection

Blind Spot Reduction

LoaderMetrics™

How LoaderMetrics helped a large copper mine avoid an estimated production loss of approximately $1.25M

Like many hard rock mines, this South American copper producer experienced significant production loss from tooth breakage each year. Between 2012 and 2015, the mine attributed 153 hours of crusher downtime to obstructions - an average of 51 hours per year. To mitigate the impact from missing loader teeth, the site installed LoaderMetrics on two loaders. Since installation, the mine has experienced zero crusher downtime due to missing loader teeth and avoided an estimated production loss of approximately $1.25M because of the missing tooth detection system.

The mine's crushers process an average of 5 kilotons per hour. If there is additional stock to provide operational support, an obstructed crusher may not immediately impact operational continuity. But, if plant operations must be halted, the cost to the mine is approximately USD $25K per hour. Thus, the roughly 50 hours of yearly lost production due to crusher obstructions costs the mine $1.25M. Over the course of a year, the system detected 12 missing loader teeth and the mine experienced zero crusher downtime – preventing the $1.25M production loss that the mine otherwise experiences in an average year.

Protected Bucket Camera

MetricsManager™ Pro

Like all Motion Metrics products, LoaderMetrics interfaces with our centralized data analysis platform, MetricsManager Pro. Users with authorized credentials can access data summaries, in-depth performance reports, surveillance logs, and particle size data from anywhere.

TruckMetrics™

Assess load characteristics
and divert boulders away from the crusher.

TruckMetrics is a complete haul truck monitoring solution that provides boulder detection, particle size analysis, load profiling, and volume sensing without interrupting production. Equipped with an automated lens cleaning system, TruckMetrics uses artificial intelligence and a 3D (stereo) camera mounted on a gantry above the haul road to provide real-time video analysis.

A single solution to **monitor the material** that is hauled to your processing plant.

Features

Boulder Detection

Minimize crusher downtime and reduce rockbreaker usage by diverting oversized material.

Particle Size Analysis

Evaluate blast performance by analyzing the particle size distribution of every truckload.

Load Profiling

Prevent uneven truck wear with accurate load profiling.

Volume Sensing

Optimize production by measuring the volume of each haul truck load.

BOULDER CONFIRMED

**Boulder Detection**

3D Imaging

TruckMetrics™

With TruckMetrics, mines can monitor the particle size distribution of each truck load on its way to the crusher and divert any oversized material. Load profiling and volume sensing provide insight into operator performance that will help mines optimize production and reduce equipment wear.

Particle size distribution

— Cumulative % ▪ Non-cumulative %
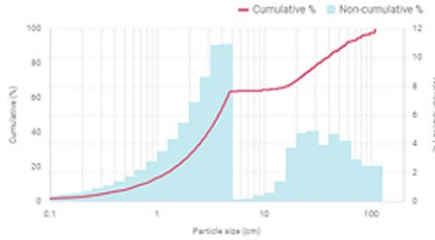
P Values

Percent passing	Value (cm)
P 100	108.8
P 80	33.3
P 50	3.8
P 20	1.6

Target size

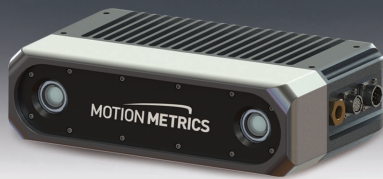| Target size (cm)	Target range (%)	Cumulative (%)
>120.0	0.0	100.0
120.0	2.4	100.0
100.0	5.8	97.6
60.0	91.8	91.8
Add a target size		

MetricsManager™ Pro

Rugged, Self-Cleaning 3D Camera

MOTION METRICS

04:37am, April 15, 2020 | SMS ALERT
Incident Report:
Boulder detected on Truck 022, Avoid crusher. Reroute to stockpile.

TruckMetrics™

MetricsManager™ Pro

Like all Motion Metrics products, TruckMetrics interfaces with our centralized data analysis platform, MetricsManager Pro. Users with authorized credentials can receive SMS and email boulder notifications, monitor truck volume for insight into shovel operator performance, and access particle size data from anywhere. Motion Metrics recognizes the importance of interoperability and will work with other vendors to ensure our solutions interface with your existing software.

BeltMetrics™

Easy and accurate 3D analysis
of the material transported by conveyor belts.

BeltMetrics uses artificial intelligence and 3D (stereo) imaging to analyze the particle size and monitor the bulk volume of material transported by conveyor belts – no belt cuts, calibration, or scaling objects required.

Real-time analysis that neither interrupts production nor requires belt cuts.

Features

Particle Size Analysis

Optimize crusher feed size with continual particle size analysis.

Empty Belt Detection

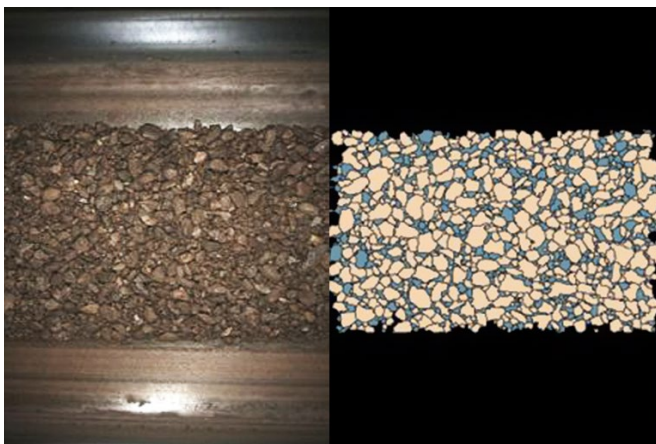Detect empty belts to alert mines to blocked chutes.

Volume Sensing

Optimize production by continually measuring transported material.

Load Profiling

Prevent uneven belt wear and conveyor damage with accurate load profiling.

Particle Size Analysis
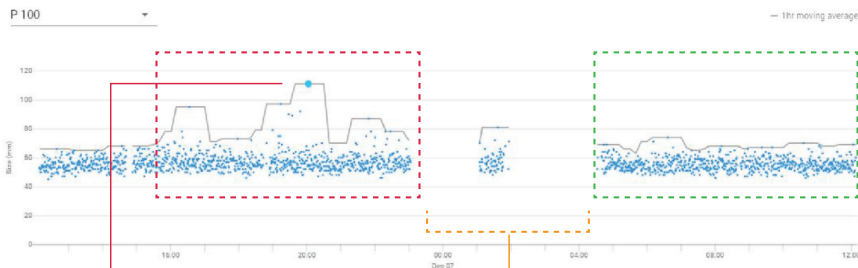

Empty Belt Detection

BeltMetrics™

How BeltMetrics helps an Australian mine prevent contamination events

Particle size distribution timeline

Oversized material detected

Belt stopped to fix screen breakage

Normal operation resumed

This iron ore mine in the Pilbara uses the BeltMetrics particle size analysis and automated notification functions to prevent contamination events.

In this **sample report,** the site receives a notification from BeltMetrics indicating that oversized material has been detected. The mine then stops the belt and fixes the screen breakage so that normal operation can resume.

Rugged, Self-Cleaning 3D Camera

Mine-to-mill optimization begins with a clear understanding and ongoing assessment of blasting, crushing, and grinding operations. BeltMetrics is an accurate alternative to sieve analysis that doesn't interrupt production. Use particle size data collected with BeltMetrics to optimize crusher gap settings.

Metrics**Manager**™ Pro

Like all Motion Metrics products, BeltMetrics interfaces with our centralized data analysis platform, MetricsManager Pro. Users with authorized credentials can access data summaries, in-depth performance reports, equipment activity logs, and particle size data from anywhere.

PortaMetrics™ Gen 2

Improve the efficiency, safety, and accuracy of your blast assessment.

Built upon over the eight years of success of the original device, the PortaMetrics Gen 2 provides a more powerful and accurate solution for portable fragmentation analysis. PortaMetrics Gen 2 uses artificial intelligence and 3D imaging to provide accurate data without the need for a reference scaling object. The device can be used to verify blasting results or provide coverage where other particle size analysis systems are not installed. Particle size analysis is available on the device and in the cloud. PortaMetrics can be used in both open pit and underground operations with adequate lighting.

PortaMetrics Gen 2 has improved upon the accuracy of its predecessor and is equipped with enhanced capabilities such as expanded storage and 50% longer battery life. Higher resistance to dusty conditions and a larger display makes PortaMetrics Gen 2 more robust and easier to use.

"PortaMetrics makes it easier to optimize our blasting parameters and reduce explosives costs throughout the operation."

Horia Moisa
Superintendent Drill and Blast, AngloGold Ashanti, Australia

Specifications

Minimum particle size detected at 5 m	4cm (1.6")
Minimum particle size detected at 10 m	6cm (2.4")
Operating distance range	2.5m - 30m
Scaling objects required	None
Ingress protection	IP64
Battery life	Up to 3 hrs
Storage	7,000 logs
Touchscreen display size	10"
Weight	3.6 kg

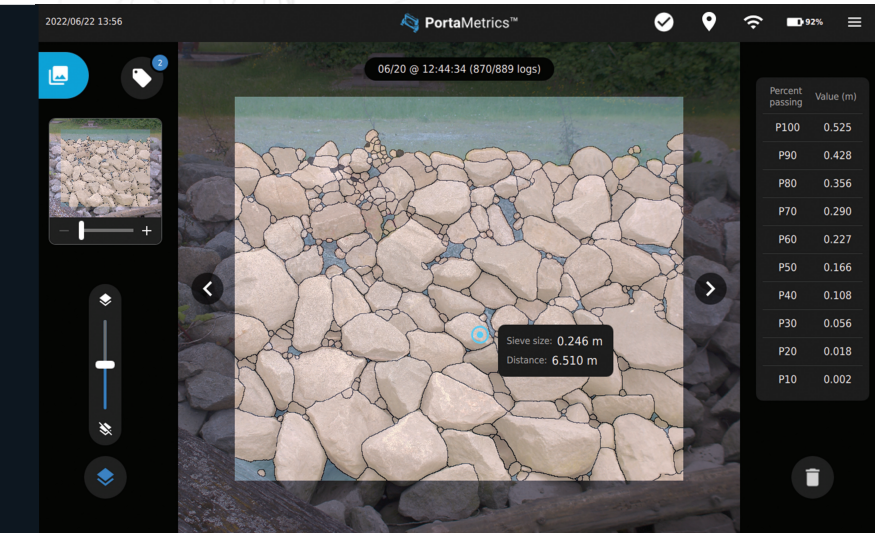**Particle Size Analysis**
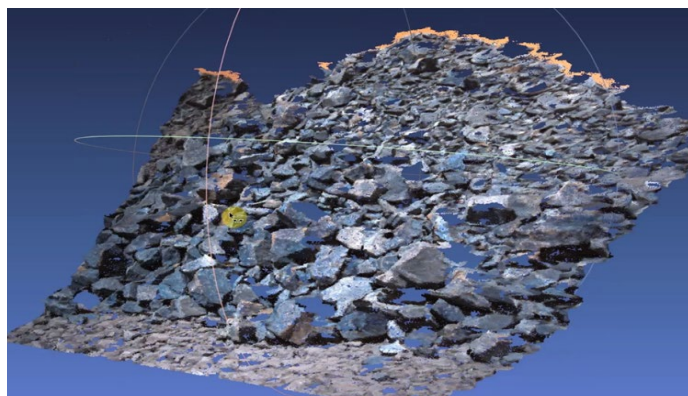
3D Imaging

PortaMetrics™ Gen 2

How PortaMetrics helped a Canadian mine save $740K on drill and blast costs by achieving a 350,000 kilogram reduction in explosives usage

A copper and gold mine in Western Canada used PortaMetrics to analyze and optimize blasting. Using particle size data collected with the device, the mine lowered its powder factor without negatively impacting fragmentation results. The mine increased its drilling capacity and drilled inventory while decreasing its drilled costs and explosives usage by using the lower powder factor.

Over the course of the study period, the total hypothetical explosives savings at the mine were an estimated 350,000 kilograms, equivalent to approximately **$740K**. The mine achieved a total drilling time saving of **~210 hours (18 shifts of drilling)**. About 350 fewer holes and 5700 fewer meters were drilled. The average blast volume per shift at a lower powder factor was **2.1 times more efficient.**

MetricsManager™ Pro

Like all Weir Motion Metrics products, PortaMetrics interfaces with our centralized data analysis platform, MetricsManager Pro. Users with authorized credentials can access particle size data from anywhere to verify and improve the effectiveness of blasting parameters. Weir Motion Metrics recognizes the importance of interoperability and will work with other vendors to ensure our solutions interface with your existing software.

About Us

A message from our Chief of AI, Shahram Tafazoli

Shahram founded Motion Metrics after completing his PhD thesis in Robotics and Intelligent Systems at the University of British Columbia (UBC). He received his bachelor and master's degrees (with honors) from Sharif University of Technology. He is an avid inventor holding numerous patents, an adjunct professor with the UBC Department of Electrical and Computer Engineering (ECE), an angel investor in many promising Canadian and international technology start-ups, and an associate member of the Creative Destruction Lab. Shahram chairs several boards of the directors and sits on advisory board of several technology companies. Shahram believes in lifelong learning.
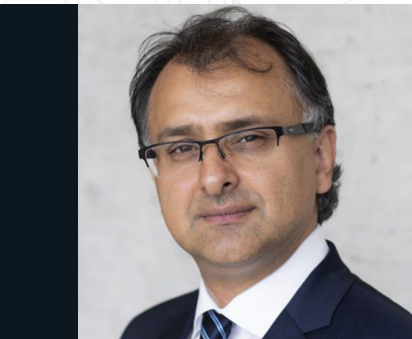
Vision

To inspire a new generation of safe, sustainable, and intelligent mining

Mission

To create and deploy innovative products that combine machine vision and artificial intelligence to solve tough mining challenges

Values

Trust, innovation, collaboration, and determination

Ajay Agrawal is a professor at the University of Toronto, Research Associate at the National Bureau of Economic Research in Cambridge, MA, Faculty Affiliate at the Vector Institute for Artificial Intelligence, and Advisory Board Member for Carnegie Mellon University's Block Center for Technology and Society. He conducts research on the economics of science and innovation and co-authored the best-selling book "Prediction Machines: The Simple Economics of Artificial Intelligence" (Harvard Business School Press, 2018) and co-edited "The Economics of Artificial Intelligence: An Agenda" (University of Chicago Press, 2019). Professor Agrawal is founder of the Creative Destruction Lab and cofounder of NEXT Canada. The Globe and Mail listed Professor Agrawal as one of the 50 Most Powerful People in Canadian Business.

Ajay Agrawal
Senior Advisor on Business Strategy and Artificial Intelligence

Affiliations

Notes

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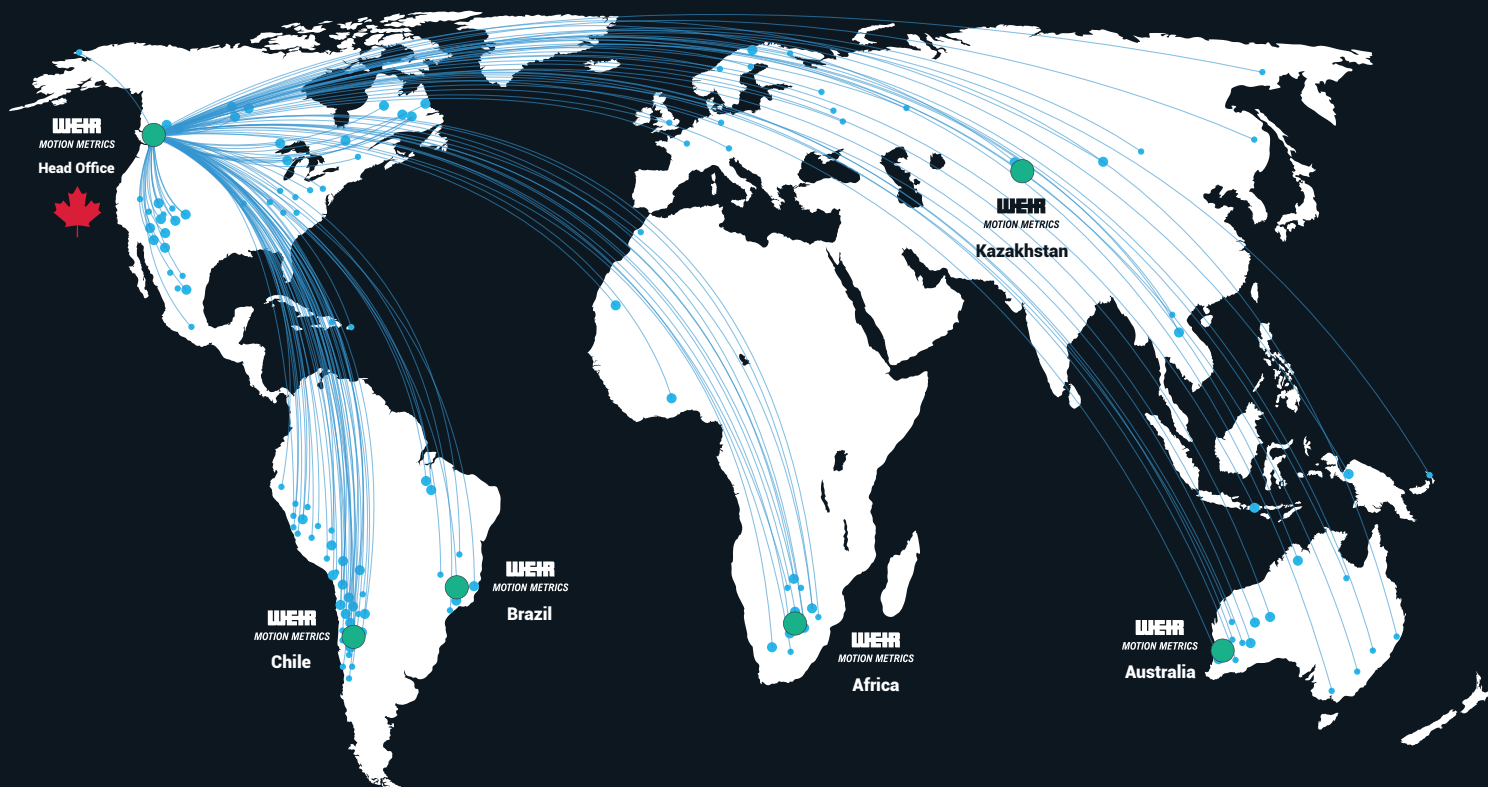
Trademark Information

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WEIR MOTION METRICS   ShovelMetrics™   LoaderMetrics™   TruckMetrics™   BeltMetrics™   PortaMetrics™ Gen2

CUSTOMERS

Our incident mitigation and energy efficiency products give mines a competitive edge in our changing world. We train our prediction models on a broad range of data from around the world to ensure that our smart systems can handle any operating environment imaginable. With offices on five continents and customers on six, Motion Metrics has been a trusted partner in mining innovation for nearly two decades.
Our global team provides fast, local support.

WEIR
MOTION METRICS

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