

Speed and Innovation: The Future of Machine Vision Standards

Presenter:

Dave Nyberg, Global Product Marketing Manager, 3M Display and Electronics



KEY TAKEAWAYS

- New trends in the machine vision industry are driving advancement of interface technology.
- 3M produces cable assemblies to help support cutting-edge applications.
- Standards Committees are exploring a new interface standard with greater scalability.

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OVERVIEW

The machine vision industry is growing rapidly, driven in part by advancement in AI-enabled applications. New technologies are also pushing data speed requirements higher, requiring cable assemblies that can accommodate image transfer at higher rates and with higher quality.

To ensure interoperability between different manufacturers and applications, interface standards are a necessity. However, an increase in speed requirements could require the development of a new interface standard. To keep pace with projected industry growth, standards committees are considering development of a new interface standard that will accommodate machine vision applications for decades to come.

3M offers a broad portfolio of camera interconnect solutions with machine vision technology to help empower machines and computers to interpret visual information with human-like comprehension. 3M solutions help provide improved performance, robustness, and reliability—in some cases at a lower total system cost. 3M offers connectors, cables, and cable assemblies for high-speed, high-density I/O applications in three machine vision standards: USB3 Vision®, Camera Link® and CoaXPress®.

CONTEXT

Dave Nyberg discussed trends in the machine vision industry and explained how 3M invests in products that enable machine vision applications today and in the future.

KEY TAKEAWAYS

New trends in the machine vision industry are driving advancement of interface technology.

The global machine vision market is on an explosive growth trajectory, driven by advances in camera technology and the increase in machine vision applications across industries.

The machine vision hardware forecast predicts market expansion to continue—and likely to accelerate as artificial intelligence (AI) and machine learning adoption grow.

Advanced applications, such as humanoid capability in robotics, medical imaging and diagnostics in healthcare, inventory control and enhanced customer experience in retail, crop management with smart agriculture, autonomous vehicles, 3D cameras, and more, require camera technology that enables processing and transmission of higher-resolution images at increasingly faster speeds.

Machine vision cable assemblies (interfaces), specifically, must be capable of handling the high data rates and demanding environmental conditions of AI-enabled applications.

“All these trends lead to the need for higher-speed, higher-resolution images—that’s really where the manufacturers of these interfaces, like 3M, come into play.”

– Dave Nyberg, 3M Display and Electronics

Figure 1: Applications such as crop management (L) and autonomous vehicles (R) depend on advanced machine vision technology



The role of machine vision in AI

Combining machine vision with AI and machine learning significantly enhances efficiency by enabling automated, accurate, and real-time inspection and decision-making processes in various industries.

AI models that have been trained on more data make more accurate decisions more quickly. Because models are trained using an iterative approach, they can be made more intelligent, faster, if the rate and resolution of image transmission increases—providing the model with a higher volume and quality of data. Camera transmission speed, therefore, is critical to enabling algorithms to learn more rapidly and to become more effective in a shorter time.

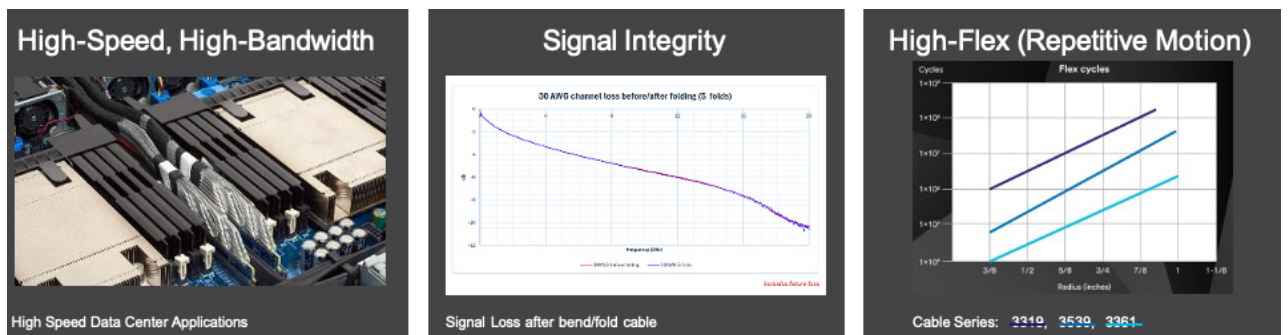
Figure 2: Machine vision cameras provide useful data to train AI models



3M produces cable assemblies to help support cutting-edge applications.

With decades of experience and knowledge in producing cable assemblies that require high speed, high bandwidth, flexibility, low loss, and high-quality functionality, 3M offers machine vision and cable assemblies that can help meet the needs of today’s cutting-edge applications.

Figure 3: 3M has experience with critical components of data transmission from other well-established cable assembly platforms that can be applied to machine vision cable assemblies



3M™ TwinAx High-Speed Cable Solutions
3M™ Expanded Beam Optical

3M™ TwinAx High-Speed Cable Solutions
3M™ EMI Materials

3M Industrial Cable Portfolio

Machine vision standards: Crucial to interoperability

With a wide array of camera manufacturers and applications in the machine vision industry, standards are key to ensuring that devices work together. The current global standards support four commonly used interfaces: **Camera Link**, **USB3 Vision**, **CoaXPress**, and **GigE**.

Global machine vision associations, such as the Association for Advancing Automation (A3) Vision & Imaging Group and the Japanese Industrial Imaging Association (JIIA), work closely with 3M and other manufacturers to develop standards that will help shape the future of the industry. Recently, association activity has focused on exploring a next-generation camera interface to help meet the industry's high-speed requirements.

Figure 4: Global machine vision standards support four interfaces



3M cable assemblies are used in a range of industries for various applications, including:

- Medical imaging (Camera Link interface).** To support diagnosis accuracy when using diagnostic imaging equipment, it is crucial that cable assemblies function correctly, especially in electronics-dense environments. Many medical imaging standards still use the Camera Link interface. As an originator of the Camera Link standard, 3M has been supporting medical equipment manufacturers with high-quality Camera Link cable assemblies for over 20 years. 3M's Camera Link cable assemblies include real-time triggering, flexible options up to 10 million cycles, angled connectors with screw locks, and EMI-shielded junction shell.

Figure 5: 3M Camera Link cable assemblies support medical imaging



- **Smart agriculture harvesting (USB3 Vision interface).** When using mobile robotic arms fitted with cameras to harvest produce and monitors mounted above, noise suppression and a space-constrained design are crucial. 3M's USB3 Vision cable assemblies provide high-speed transmission and include flexible options greater than 100 million cycles to ensure signal integrity, and angled connectors/screw lock for tight and durable connections.

Figure 6: 3M USB3 Vision cable assemblies support smart agriculture harvesting



- **Semiconductor equipment (CoaXPress interface).** Durability and reliability are essential when operating production lines. Semiconductor test and measurement equipment requires real-time triggering, high-speed and high-resolution imaging to help ensure product quality. 3M's CoaXPress cable assemblies maintain performance over long cable length and offer high-speed data transfer up to 12.5 Gbps/channel, real-time triggering, and flexible options greater than 45 million cycles.

Figure 7: 3M CoaXPress cable assemblies support production line automation



Standards Committees are exploring a new interface standard with greater scalability.

Over the past three decades, as data transfer speeds increased, new interfaces had to be developed to support higher networking speeds. At the same time, as speed requirements of applications increased, the form factor also changed: each iteration has yielded a different camera model and design.

These changes to the interface cable and form factor have created challenges for end users trying to create compatibility and redundancy in their systems—and speeds only continue to increase.

To address this issue, standards committees are now assessing the development and adoption of a new interface standard that will meet industry needs well into the future.

One potential answer is fiber optics. On fiber optic cable, data travels at the speed of light, enabling data to travel extremely long distances without losing strength. Standards committees are working to determine whether the speed and quality of fiber optics can be harnessed into an affordable and usable interface standard for machine vision camera applications.

“Fiber optic has some merits here . . . there’d be enough built-in capacity with fiber optics and the connectivity around the form factors that are in use today to meet the needs of the requirements for cameras for decades to come.”

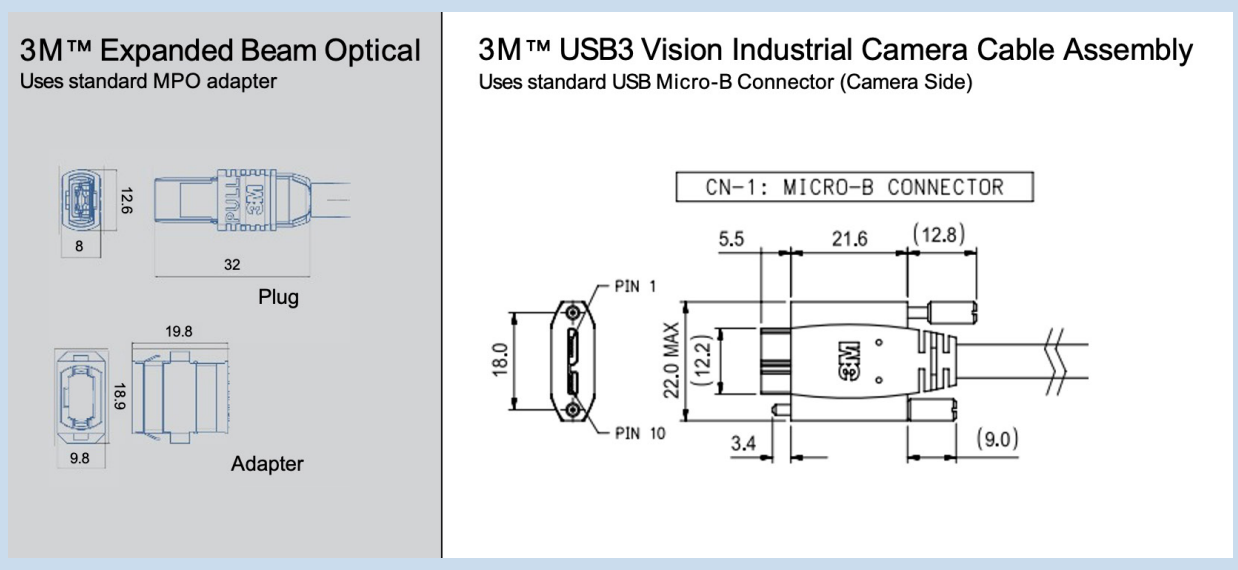
– Dave Nyberg, 3M Display and Electronics

3M Expanded Beam Optical Ferrule

The 3M Expanded Beam Optical Ferrule uses a non-contact optical coupling in contrast to the more traditional physical contact methods. The ferrule offers a durable connection for harsh environments and protection against contamination, helping maintain signal integrity and reduce maintenance.

While the small size of machine vision cameras can present a challenge when trying to fit a fiber optic option on the camera or a connector, the 3M adapter and plug size is smaller than USB connectors used in cameras today.

Figure 8: 3M optical connector size compared to current interface standards



ADDITIONAL INFORMATION

To learn more, visit [3M](#) and [TTI](#)

BIOGRAPHY



Dave Nyberg

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Dave Nyberg is a Global Marketing Manager, and he has worked at 3M for over 23 years. He has diverse experience across several industries and joined his current division, Electronics Materials Solutions, over 8 years ago. Within the Electronics Materials Solutions business group, he has managed businesses and marketing activity related to Power Generation and Distribution, Safety and Sustainability, Semiconductors, and most recently Interconnect and Industrial Automation. Dave has college degrees in Physics and Engineering and prior to joining 3M, Dave worked as a consulting engineer. He resides near the 3M headquarters in St. Paul, MN.