Accessing the Benefits of 4K/UHD in Railway Inspection

How VEGA Products Can Help Enhance Performance and Reliability of Train Services

Introduction

Periodic track and power line inspection by railway operators is essential to help maintain good service and reduce disruption. With modern railway carrying heavier loads at faster and faster speeds, the need for extensive and accurate surveys of track and power conductor infrastructure to spot actual and even potential faults quickly and effectively is growing. With more trains, reduced down-time, and pressure on costs, improving productivity is an urgent business-critical task for maintenance planning.

Automated inspection systems are not new, but quicker, more efficient inspection methods are needed. One way to improve productivity is by the use of higher resolution cameras such as 4K/UHD coupled with Artificial Intelligence (AI) and Machine Learning (ML) systems to analyze the data captured. The extra resolution improves potential accuracy, and the AI/ML can quickly sift through a massive amount of data to flag potential issues for further review.

The problem with increasing resolutions is the amount of data that needs to be captured increases exponentially, and the amount of processing power required to analyze it increases in proportion. Advantech can help equipment makers to take advantage of the potential benefits of 4K/UHD based inspection by providing a range of high quality video compression engines that can be used to improve storage performance and transmission efficiency whilst retaining a compact, robust form-factor. This paper describes how.

Key Application Requirements

Where an inspection setup can upgrade to multiple 4K/UHD cameras to provide high levels of detail for later offline analysis, the main issue is one of capturing and storing such a large amount of data reliably, and also allowing this to be uploaded from the inspection vehicles quickly. The solution is to use proven High Efficiency Video Coding (HEVC) to compress the video prior to storage. HEVC, also known as H.265 was introduced in 2013 and offers substantial improvements in compression efficiency over previous commonly used codecs, but at the cost of much higher computational complexity.

The focus, therefore, is on providing high quality 4K/UHD live compression and recording at high speed – up to 60 frames per second – for multiple cameras, in as compact a package as possible. Every frame matters.

Some of the key challenges and requirements include:
- Retain image accuracy at speed: reliably encode 4K 10bit at a solid 60fps
- Good Compression: eliminate picture encoding artefacts and noise on every frame
- Multiple channels: Support many cameras simultaneously
- Limited space: allows this to be installed on normal rolling stock
- Harsh environment: has to tolerate elevated shock & vibration

How Advantech Can Help

In environments like this, using software alone is unrealistic. Only HEVC hardware codecs offer the balance of tunable real-time sustained performance and small footprint. Advantech's Video Solutions Division offers a range of low power, high performance video capture and encoding accelerators that are particularly suitable for robust video compression and storage applications. The acceleration products, under the VEGA family name, include modules boards and systems all capable of 4K/UHD live HEVC encoding at 60fps, many with 4:2:2 support, and all with low power, compact size and high video quality.

Of particular benefit are:

VEGA-3311: Single channel 4K/UHD or 4 x 1080p 60fps 10bit 4:2:2 capable hardware HEVC/AVC encoder accelerator plug in board with a variety of direct video capture options including 4 x 3G SDI, 1 x 12G SDI. As a PCIE plug-in card, VEGA-3311 can be used to add real-time HEVC encoding to existing equipment, or can be used along with Advantech's flexible VEGA-7010 server to create multi-channel compression and storage or streaming appliances. The VEGA-3311 offers a high degree of programmability via either a dedicated SDK or a simple-to-integrate FFMPEG plug-in, and Advantech can offer further customization services to adjust output for specific requirements.

VEGA-7010: Highly flexible video appliance platform offering unparalleled flexibility in a 1U short depth profile with 4 full height PCI Express slots and a server class Xeon E3 CPU. The VEGA-7010 can fit in 600mm racks such as those used in trucks or small equipment closets, offers redundant power supplies, robust cooling, and expandable storage. The VEGA-7010 can support up to four VEGA-3311 boards giving 4 x 4K/UHD live contribution channels per 1U appliance in under 300W total power consumption. With this level of performance, the server can efficiently offload heavy-lifting video processing and storage tasks in live workflows and significantly improve density, scalability and cost of live UHD video solutions.

Real Life Use Case

A market-leading railway inspection equipment provider in Japan was looking to upgrade their train-mounted measuring rig to use 4K cameras in order to improve accuracy of fault detection using automated analysis. A total of 8 cameras are pointed at tracks, conductors and surroundings. The massive amount of data produced by these 8 cameras needed to be compressed and cached locally before being uploaded to the operator's private cloud using line-side or platform network.

The key requirements were to have fine-grain control of the encoder output pictures to reduce the incidence of noise or other encoding artefacts that might have created false-positive fault indications, and to have the encoding part be small enough and robust enough to fit in the limited space on the trains.

The Advantech VEGA product line and Advantech's software customization service provided the solution. The entire encoding, local storage and cloud streaming portion was able to fit on two VEGA-7010 short-depth servers, each with four VEGA-3311 video capture and encode acceleration cards. That's eight separate 4K/UHD encoding streams in approximately 600W total power consumption. Advantech also customized the encoder SDK to offer special configuration for the GOP structure and to reject pictures with excessive noise.
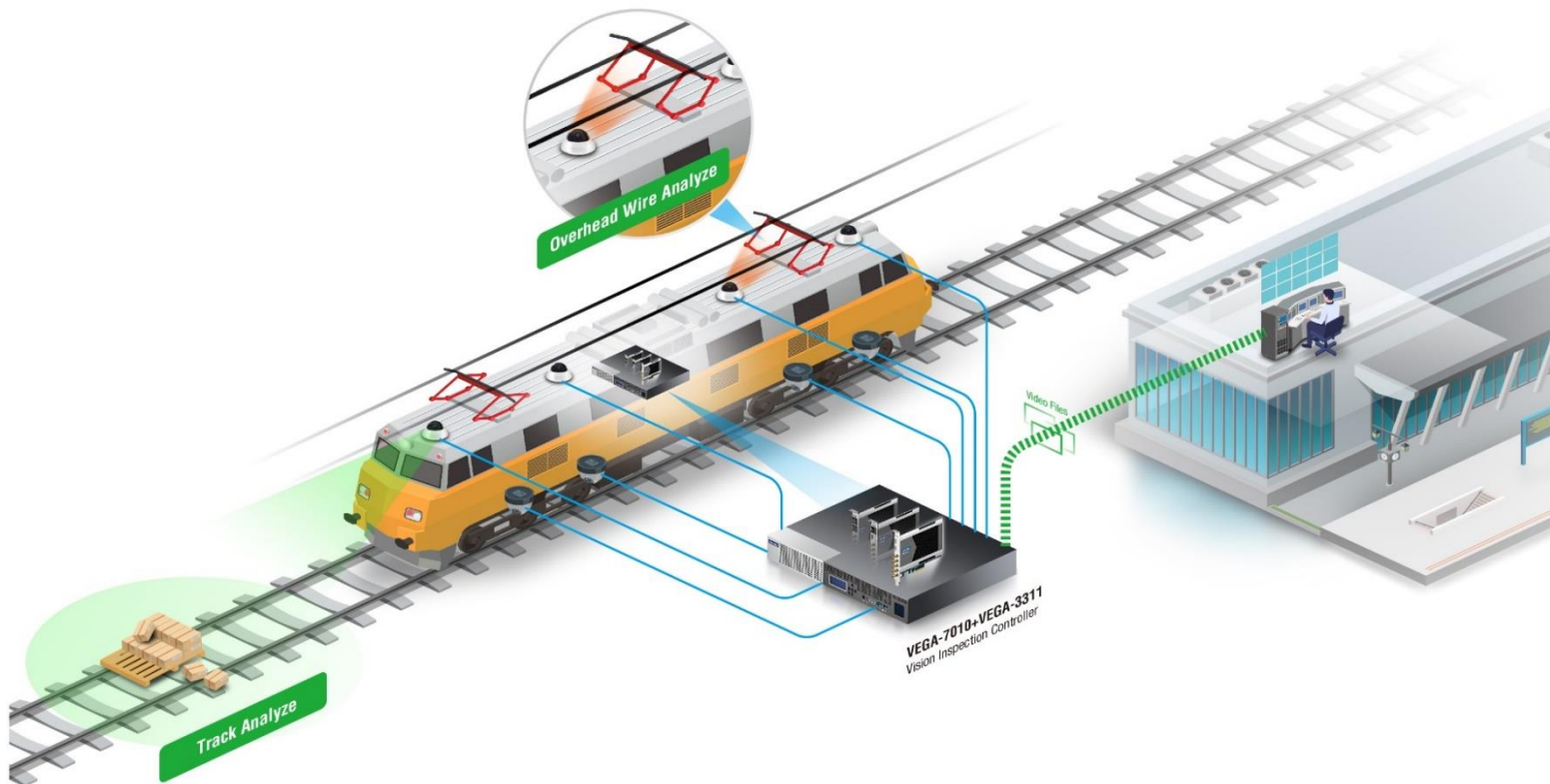
Advantech VEGA Benefits:

- **Robust acquisition support:** raw video from 4K cameras can be reliably acquired by the VEGA-3311 via a built-in 12G-SDI input and be encoded directly. The locking BNC form of SDI connector is valuable in a high-vibration environment.

- **High quality video encoding:** the VEGA-3311 supports professional grade 4Kp60 10-bit 4:2:2 HEVC encoding. The hardware-based solution is ideal for compression with guaranteed live performance at high bit rates enabling high quality results without frame drop.

- **Integrated Video Solution Provider:** Advantech offers a one-stop shop video solution including the power-efficient video server and high performance 4K encoding accelerator cards, plus with our dedicated R&D support and global experience, we deliver states-of-the-art products and real-time service

Products Used in this Project:
- VEGA-7010 High Density 1U Rack-mount Video Server
- VEGA-3311 4K HEVC Broadcast Video Encoding / Decoding Card
- Advantech customized video SDK

Summary

Advantech's video solutions, including video server and 4K/UHD PCIe encoding cards, offer customers a cost-effective contribution grade 4K encoding solution without compromising operational efficiency, floor space, power consumption and total cost of ownership (TCO). It's an ideal solution where live encoding performance with high video quality is required in a compact space and low power.

Although this example focused on railway inspection, the same tools and techniques are applicable to many other automatic inspection or recording applications requiring multiple proven real-time 4K encoders in a compact space.

Advantech Contact Information

Hotline Europe: 00-800-248-080 | Hotline USA: 1-800-866-6008

Email: video.solutions@advantech.com

Regional phone numbers can be found on our website at
http://www.advantech.com/contact/

https://www.advantech.com/solutions/video-solution