SUCCESS STORY

Ultrasound Diagnostic Railway Car with Basler scout GigE Cameras for Synchronized Visual Inspection

Customer

- Name: Polish Railway Center for Diagnostics
- Location: Poland
- Industry: Quality inspection of railway tracks
- Year of Realization: 2011

Application

The inspection of railway tracks on a regular basis is key to ensuring the safety of rail transportation. Among the many examination techniques employed by modern railway companies, ultrasound (US) nondestructive testing is an especially good method. It is nonintrusive, cost effective, and relatively easy to engineer. An ultrasound probe bursts a beam of sound waves with frequencies between 1 and 10 MHz. The waves propagate deeply into a rail, and at any discontinuity, they are reflected back to the probe. The signal registered for such a reflection is called an echo, and its time of arrival is a measure of the distance between the probe and the discontinuity. Normally, an echo is caused by the outer boundaries of the rail, but any earlier occurrence is potentially a sign of a hidden flaw.

The ultrasound method is easy to automate. Usually a combination of probes emitting waves from different angles is used, and the emission/registration cycle is repeated progressively along the length of the rail. The measurement setup is mounted on a specialized ultrasound diagnostic car running along the railway at high speed and performing the ultrasound testing with a repetition rate on the order of a few kHz.

The automated system benefits greatly if it is coupled with another testing method based on visual inspection via a digital camera. Many strong ultrasound echoes simply result from the holes used for joints, signals, blocks, etc. Ideally, each strongly registered echo should be evaluated based on an image of the rail that is synchronized with the ultrasound signals.

Producing a highly capable diagnostic railroad car is a demanding technical challenge. In terms of the visual inspection part of the diagnostics, the car runs at a speed of about 60 km/h. To produce a geometrically correct picture with a resolution on the of the order of 1mm, the field of view usually needs to be set to 0.5 meter. Due to the high vibration level of the car, area scan cameras must be used, and to limit the linear motion blur, a very short exposure time is required. The nominal 60 km/h speed is equivalent to approximately 17 mm per millisecond. To achieve the target resolution of 1mm, the exposure time must be set to about 50 microseconds. At the same time, image acquisition must not be dependent on the ambient environmental illumina-

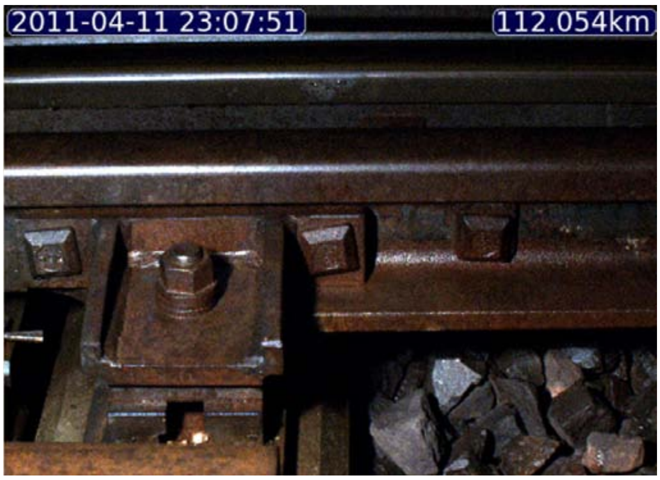

Image of Railway Track Captured at Night With Rain

Ultrasound cars are driven in every weather condition imaginable from early spring to late autumn, in heavy sunlight or in rain, and sometimes at night. Given these constraints, the only practical option for illuminating the scene is the high light intensity of a discharge lamp, such as a xenon flash lamp, strictly synchronized with the movement of the car and the trigger used for image acquisition. Of course, because common types of xenon lamps offer only a 10 Hz discharge rate and a mean lifetime of one million discharges, triggering a xenon lamp with the required 30 Hz frequency and 200,000 pulses per 100 km of testing is a problem in itself.

Image of Railway Track Captured With Sunlight

Solution and Benefits

Three Polish companies, Ultramet, Cilantro, and Avicon, cooperated with the Polish Railway Center for Diagnostics to address the technical challenges outlined above and achieve the successful implementation of an ultrasound testing car.

Ultramet is a company with a great deal of experience in constructing specialized ultrasound flaw detectors.

Cilantro, a software company dealing mainly with specialized software for automated industrial measurement instruments, designed the entire IT system for the project.

Avicon, Basler's Polish distributor, was responsible for the selection and delivery of the appropriate video solutions including: cameras, illumination, a data exchange method, and core software. They were also responsible for proving the system via preliminary field tests.

The modernized, fourth edition of the car was put into use this year. The car uses four Basler scout GigE cameras looking at the top and side surfaces of each rail. The scene is illuminated by two xenon illuminators that incorporate very high quality, long life, high discharge rate flash lamps. The specialized digital ultrasound equipment is driven by a computer system that also produces the regular trigger pulses needed for the cameras and xenon strobes. Each acquired image is transmitted from the cameras to the Linux-based proprietary video recording system via the GigE interface. The recording rate is 30 frames per second. Most of the acquired frames are compressed, but frames from the regions where the ultrasound equipment has detected a flaw are stored in the system in an uncompressed format.

The Basler scout GigE cameras proved to be particularly well suited for such an application. They offer a rich, versatile set of triggering and exposure options, allowing for precise synchronization with xenon strobes. The flexible GigE interface, along with the pylon SDK for Linux, supported smooth integration with the system's proprietary software. The results meet the required inspection criteria and help to ensure the safety of anyone riding the Polish rails.

Technologies Used

- 4 Basler scout GigE scA1300-32gc cameras
- pylon SDK for Linux
- Xenon illuminators

More Information

Basler distributor in Poland: www.avicon.pl

Basler scout

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