Rockfall monitoring with a LIDAR optical fence
Overview of Requirements

The following list highlights the Class 1 freight railroad’s requirements:

- A LIDAR fence must be set up along the length of track susceptible to rockfall, with a minimum number of LIDAR heads providing redundant coverage of adjacent LIDAR’s track.
- The LIDAR fence must detect a 12 inch diameter or larger object when in the rails or foul of the track.
- No alarm made for train passing.
- Discrete interfacing for use with existing Class 1 freight railroad detection processors.
- Fail safe (alarm output for health of unit).
- Detect on both straight and curved track.
- Distinguish boulders and rocks from landslides.

Requirement

For freight rail operators any delay, no matter how small, not only increases costs due to reduced train speeds and late arriving shipments but may also slow down trains that follow.

A key issue confronting operators is rockfall blocking rail lines which is especially likely where the track passes through mountainous areas and steep rock cuttings.

Conventional means of detecting these occurrences is via a slide fence. When a rock breaks the wire, a signal is sent to the local maintenance engineers who then need to establish what has happened. The train must then run with a restricted speed of 20 mph pending the investigation.

Our Solution

L.B. Foster is an established supplier of LIDAR detection systems for Level Crossing applications in Europe. Our Nottingham-based Technology Centre immediately rose to the challenge of evolving our dual-LIDAR Level Crossing Product in to a multiple head LIDAR fence that can accommodate long stretches of rockfall-susceptible track.

The chosen site for a trial LIDAR fence was on the Class 1 freight railroad’s Washington track along the banks of the Columbia River. The area known as Fallbridge possesses 600 feet (185 meters) of fracturing shale rock in near vertical cliffs adjacent to the track.

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CASE STUDY

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Solution details

Using 10 LIDAR heads mounted to the existing slide fence supports, the system is planned for a year-long trial to verify the added benefits of LIDAR. With this system installed there is no requirement for a slide fence to be in place.

The fully installed and commissioned system is shown in the following photograph (right).

Each LIDAR in the illustration below covers not only its own area of track, but also its neighboring LIDARs, hence we have dual redundancy in the design to still detect if an obstacle sits on the track even if one LIDAR head fails.

While the train is in transit through the detection area, the LIDAR optical windows are shuttered to prevent detection of the train and also to protect them from dirt and stones thrown up from the passing train.

Trains would only be subject to restricted speed with this system if there is a stationary obstacle of over 12 inches in dimensional size on the track.

The system as it is trialed relies on simple obstacle detection within the area of interest set for each LIDAR head; this area of interest can be changed depending on track layout, configuration and number of parallel track lines.

The length of monitored area is not constrained and LIDARs may be installed to monitor sections of track from tens of feet to more than several miles in length.

A further benefit of the L.B. Foster Rockfall system is that it is easily expandable to provide both transitory object detection (animals, intruders and other events such as heavy snowfall), and discriminate against an actual obstacle. It will also ultimately be capable of interfacing to signaling systems via an appropriate SIL safety level approval. L.B. Foster is currently designing level crossing obstacle detectors to SIL3 level in Europe.

Solution Overview

Above is a layout diagram of the LIDAR Rockfall Detection system. Details are as follows:

1. LIDAR posts and units
2. Detection range
3. Connections between each LIDAR unit
Benefits Overview

With a conventional slide fence, no knowledge of whether the rock that broke the fence now blocks the track is gained. With the LIDAR system, the precise position and width of the obstructing rock can be fed to a central control room (subject to data connectivity), or otherwise via a simple relay output to send an alarm signal from a specific LIDAR to alert maintenance engineers.

The size of the object may be determined in the event of multiple LIDAR heads detecting obstructions. Detecting landslips or large falls of rock are simply a matter of seeing how many detection zones for the array of LIDAR heads are alarmed at once.

The obvious benefits in knowing that a rock has actually stayed on the track are enormous; no longer does a site engineer automatically have to travel to the site, while a train is running at restricted speed by having to travel at only 20mph on this leg of its journey. Even if a rock is detected by the LIDAR fence to have fallen and impacted through the track, trains may be run at lower speed if the rock is no longer on the track itself, just to ensure no adverse rail damage has been incurred.

In summary the LIDAR system provides a method of actually detecting obstacles on the track itself, to enable the need to send an engineer to a sometimes quite remote site. Currently, trains are delayed at signal while this happens, delaying both their shipments and those of the following trains, incurring costs along the way. The Rockfall LIDAR system optimizes both detection of hazardous obstacles on track as well as the throughput of trains on their journey through rockfall prone territory.

Additional Benefits

- No heavy construction equipment required to install
- Continues to detect after an alarm
- Differentiates between object size
- Event recording capable
- An alarm doesn’t require expensive repairs
- Low product life cycle lost