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Modeling and Detecting Damage in Rails & Avoidance of Collision in the Tracks

Ramesh Shunmugam, Ramesh.K
(*ECE Department, Embdedded Systems Technology, SRM University*)

Abstract-- One of the major problems that railroads have faced since the earliest days is the prevention of service failures in track. As is the case with all modes of high-speed travel, Rail is manufactured in different weights; there are different rail conditions wear, corrosion etc. present there are a significant number of potential defects possible and the task has to be performed with some speed to reliably inspect the thousands of miles of track stretching across the land failures of an essential component can have serious consequences. The main problem about a railway analysis is detection of cracks in the structure. If these deficiencies are not controlled at early stages they might cause huge economical problems affecting the rail network unexpected requisition of spare parts, handling of incident and/or accidents. The main part of the work was to carry out a feasibility study on two methods for detection of cracks in the tracks and avoidance of the collision between the rails. The detection of cracks can be identified using the UVRays, CAN Controller & GSM. The avoidance of collision can be carried out using IR Rays.

Keywords-- Avoidance, Cracks, CAN Controller, Detection, GSM, IR & UV Rays

I. Introduction

Today, rail networks across the world are getting busier with trains travelling at higher speeds and carrying more passengers and heavier axle loads than ever before. The combination of these factors has put considerable pressure on the existing infrastructure, leading to increased demands in inspection and maintenance of rail assets. The expenditure for inspection and maintenance has thus, grown steadily over the last few years without however being followed by a significant improvement of the industry's safety records. As a direct consequence the immediate key challenges faced by the rail industry are: The improvement in the safety of the railway system, the development of new railways to accommodate the continued growth in demand, and Contributing to a more sustainable railway, in both environmental and financial terms, by delivering further efficiencies and exploiting technological innovation. High safety standards required in the management of railroad lines demand the inspection of railway wheels directly after production in order to detect the presence of surface cracks that could seriously affect the integrity of the railway, and therefore passengers' safety. During the last one year, we have been developing the proposed system for the detection of cracks. The main goal was to develop the highly reliable system based on detection of cracks using UV rays i.e., UV transmitter and receiver to avoid future accidents. The system is based on UV rays with signal lamp will acts as a UV receiver and it will be connect to the CAN Controller and to the GSM. By this technique the cracks are visible and they can easily see in the nearest railway station and as well as it will indicate to the engine also. So finally engine detects the alarm and engine driver will stop the train to prevent from the big Disaster. The avoidance of collision can be carried out using IR Rays. For example the two trains at different destinations i.e., from Tambaram to Chengalpattu in case two train start at different direction one train goes to Tambaram another for Chengalpattu but there is one single line so in this case severe clash will happen. In order to avoid this, our proposed model will save the train. Here we are going to pass the IR rays from the engine likewise opposite train engine also have the same rays at one particular distance the two rays will get collide and get reflected back to the engines so the alarm detects in the engine and driver will stop the train.

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II. Detection of Cracks Foundations

The detection of Cracks can be identified using UV rays with the UV transmitter and receiver. UV receiver is connected to the Signal Lamp and it will acts as Sensor. CAN Controller is connected to the main node and it sends the information via GSM and transmits the message to engine and to the nearest station.

A. UV Rays

Ultraviolet (UV) radiation is electromagnetic radiation of a wavelength shorter than that of the visible region, but longer than that of soft X-rays. It can be subdivided into near UV (380–200 nm wavelength) and extreme or vacuum UV (200–10 nm). When considering the effects of UV radiation on human health and the environment, the range of UV wavelengths is often subdivided into UVA (380–315 nm), also called Long Wave or "backlight"; UVB (315–280 nm), also called Medium Wave; and UVC (280-10 nm), also called

Short Wave or "germicidal". The name means "beyond violet" (from Latin ultra, "beyond"), violet being the colour of the shortest wavelengths of visible light. Some of the UV wavelengths are colloquially called black light, as it is invisible to the human eye. The solar corona as seen in "deep" ultraviolet light at 17.1 nm by the Extreme ultraviolet Imaging Telescope instrument aboard the SOHO spacecraft. The Sun emits ultraviolet radiation in the UVA, UVB, and UVC bands, but because of absorption in the atmosphere's ozone layer, 99% of the ultraviolet radiation that reaches the Earth's surface is UVA. Some of the UVC light is responsible for the generation of the ozone. Ordinary glass is transparent to UVA but is opaque to shorter wavelengths. Silica or quartz glass, depending on quality, can be transparent even to vacuum UV wavelengths. The onset of vacuum UV, 200 nm, is defined by the fact that ordinary air is opaque below this wavelength. This opacity is due to the strong absorption of light of these wavelengths by oxygen in the air. Pure nitrogen less than about 10 ppm oxygen is transparent to wavelengths in the range of about 150–200 nm. This has wide practical significance now that semiconductor manufacturing processes are using wavelengths shorter than 200 nm. By working in oxygen-free gas, the equipment does not have to be built to withstand the pressure differences required to work in a vacuum. Some other scientific instruments, such as circular dichroism spectrometers, are also commonly nitrogen purged and operate in this spectral region. Soon after infrared radiation had been discovered, the German physicist Johann Wilhelm Ritter began to look for radiation at the opposite end of the spectrum, at the short wavelengths beyond violet. In 1801 he used silver chloride, a light-sensitive chemical, to show that there was a type of invisible light beyond violet, which he called chemical rays. At that time, many scientists, including Ritter, concluded that light was composed of three separate components: an oxidising or calorific component (infrared), an illuminating component (visible light), and a reducing or hydrogenating component (ultraviolet). The unity of the different parts of the spectrum was not understood until about 1842, with the work of Macedonia Melloni, Alexander-Edmond Becquerel and others.UV Light have many uses. Some of them are as follows:

Black lights

A black light is the name commonly given to a lamp emitting almost entirely UV radiation and very little visible light. Ultraviolet radiation itself is invisible, but illuminating certain materials with UV radiation prompts the visible effects of fluorescence and phosphorescence. Black light testing is commonly used to authenticate antiques and bank notes. The fluorescence it prompts from certain textile fibers is also used as a recreational effect.

Flourescent lamps

Fluorescent lamps produce UV radiation by the emission of low-pressure mercury gas. A phosphorescent coating on the inside of the tubes absorbs the UV and becomes visible. The main mercury emission wavelength is in the UVC range. Unshielded exposure of the skin or eyes to mercury arc lamps that do not have a conversion phosphor is quite dangerous. The light from a mercury lamp is predominantly at discrete wavelengths. Other practical UV sources with more continuous emission spectra include xenon arc lamps commonly used as sunlight simulators, deuterium arc lamps, mercury-xenon arc lamps, metal-halide arc lamps, and tungsten-halogen incandescent lamps.

Spectrophotometry

UV radiation is often used in visible spectrophotometry to determine the existence of fluorescence a given sample.

Photolithography

Ultraviolet radiation is used for very fine resolution photolithography, a procedure where a chemical known as a photo resist is exposed to UV radiation which has passed through a mask. The light allows chemical reactions to take place in the photo resist, and after development (a step that either removes the exposed or unexposed photo resist), a geometric pattern which is determined by the mask remains on the sample. Further steps may then be taken to "etch" away parts of the sample with no photo resist remaining.

UV radiation is used extensively in the electronics industry because photolithography is used in the manufacture of semiconductors, integrated circuit components and printed circuit boards.

Checking electrical insulation

A new application of UV is to detect corona discharge (often simply called "corona") on electrical apparatus. Degradation of insulation of electrical apparatus or pollution causes corona, wherein a strong electric field ionizes the air and excites nitrogen molecules, causing the emission of ultraviolet radiation. The corona degrades the insulation level of the apparatus. Corona produces ozone and to a lesser extent nitrogen oxide which may subsequently react with water in the air to form nitrous acid and nitric acid vapours in the surrounding air.

Sterilization

Ultraviolet lamps are used to sterilize workspaces and tools used in biology laboratories and medical facilities. Conveniently, low pressure mercury discharge lamps emit about 50% of their light at the 253.7 nm mercury emission lines which coincides very well with the peak of the germicidal effectiveness curve at 265 nm. UV light at this wavelength causes adjacent thymine molecules on DNA to dimerize, if enough of these defects accumulate on a microorganism's DNA its replication is inhibited, thereby rendering it harmless. Since microorganisms can be shielded from ultraviolet light in small cracks and other shaded areas, however, these lamps are used only as a supplement to other sterilization techniques.

Fire detection

Ultraviolet (UV) detectors generally use either a solid-state device, such as one based on silicon carbide or aluminium nitride, or a gas-filled tube as the sensing element. UV detectors which are sensitive to UV light in any part of the spectrum respond to irradiation by sunlight and artificial light. A burning hydrogen flame, for instance, radiates strongly in the 185 to 260 nanometre (1850 to 2450 angstrom) range and only very weakly in the IR region, while a coal fire emits very weakly in the UV band yet very strongly at IR wavelengths; thus a fire detector which operates using both UV and IR detectors is more reliable than one with a UV detector alone. Virtually all fires emit some radiation in the UVB band, while the Sun's radiation at this band is absorbed by the Earth's atmosphere. The result is that the UV detector is "solar blind", meaning it will not cause an alarm in response to radiation from the Sun, so it can easily be used both indoors and outdoors.

UV detectors are sensitive to most fires, including hydrocarbons, metals, sulphur, hydrogen, hydrazine, and ammonia. Arc welding, electrical arcs, lightning, X-rays used in non-destructive metal testing equipment (though this is highly unlikely), and radioactive materials can produce levels that will activate a UV detection system. The presence of UV-absorbing gases and vapours will attenuate the UV radiation from a fire, adversely affecting the ability of the detector to "see" a flame. Likewise, the presence of an oil mist in the air or an oil film on the detector window will have the same effect.

B. Signal Lamp

A signal is a mechanical or electrical device erected beside a railway line to pass information relating to the state of the line ahead to train drivers/engineers. The driver interprets the signal's indication and acts accordingly. Typically, a signal might inform the driver of the speed at which the train may safely proceed, or it may instruct the driver to stop.

(Fig2.1.Signal lamp)

C. Application and positioning of signals

Originally, signals displayed simple stop/proceed indications (Fig: 2.2). As traffic density increased, this proved to be too limiting, and refinements were added. One such refinement was the addition of distant signals on the approach to stop signals. The distant signal gave the driver/engineer warning that he was approaching a signal which might require a stop. This allowed for an increase in speed, since trains no longer needed to be able to stop within sighting distance of the stop signal. Under timetable and train order operation, the signals did not directly convey orders to the train crew. Instead, they directed the crew to pick up orders, possibly stopping to do so if the order warranted it.

Signals are used to indicate one or more of the following:

- That the line ahead is clear (free of any obstruction) or blocked.
- That the driver has permission to proceed.
- Those points (also called switch or turnout in the US) are set correctly.
- Which way points are set?
- The speed the train may travel.
- The state of the next signal.
- That the train orders are to be picked up by the crew.
- Signals can be placed:
- At the start of a section of track.
- On the approach to a movable item of infrastructure, such as points/switches or a swing bridge.
- In advance of other signals.
- On the approach to a level crossing.
- At a switch or turnout.
- Ahead of platforms or other places that trains are likely to be stopped.
- At train order stations.

'Running lines' are usually continuously signalled. Each line of a double track railway is normally signalled in one direction only, with all signals facing the same direction on either line. Where 'bi-directional' signalling is installed, signals face in both directions on both tracks (sometimes known as 'reversible working' where lines are not normally used for bi-directional working). Signals are generally not provided for controlling movements within sidings or yard areas.

D. Aspects and indications

A British lower quadrant semaphore stop signal with subsidiary arm below. Signals have aspects and indications. The aspect is the visual appearance of the signal the indication is the meaning. In American practice the indications have conventional names, so that for instance "Medium Approach" means "Proceed at not exceeding medium speed prepared to stop at next signal". Different railroads historically assigned different meanings to the same aspect, so it is common as a result of mergers to find that different divisions of a modern railroad may have different rules governing the interpretation of signal aspects. A Finnish distant signal at the western approach to Muhos station is displaying Expect Stop. In the background, express train 81 is pulling away from the station. It is important to understand that for signals that use colour aspects, the colour of each individual light is subsumed in the overall pattern. In the United States, for example, it is common to see a "Clear" aspect consisting of a green light above a red light. The red light in this instance does not indicate "Stop"; it is simply a component of a larger aspect. Operating rules normally specify that when there is some imperfection in the display of an aspect (e.g., an extinguished lamp), the indication should be read as the most restrictive indication consistent with what is displayed. Signals control motion past the point at which the signal stands and into the next section of track. They may also convey information about the state of the next signal to be encountered. Signals are sometimes said to "protect" the points/switches, section of track, etc. that they are ahead of. The term "ahead of" can be confusing, so official UK practice is to use the terms in rear of and in advance of. When a train is waiting at a signal it is "in rear of" that signal and the danger being protected by the signal is "in advance of" the train and signal.

(Fig2.2.Aspects & indications)

A distinction must be made between absolute signals, which can display a "Stop" (or "Stop and Stay") indication, and permissive signals, which display a "Stop & Proceed" aspect. Furthermore, a permissive signal may be marked as a Grade Signal where a train does not need to physically stop for a "Stop & Proceed" signal, but only decelerate to a speed slow enough to stop short of any obstructions. Interlocking ('controlled') signals are typically absolute, while automatic signals (i.e. those controlled through track occupancy alone, not by a signalman) are usually permissive. Drivers need to be aware of which signals are automatic. In current British practice for example, automatic signals have a white rectangular plate with a black horizontal line across it. In US practice a permissive signal typically is indicated by the presence of a number plate. Some types of signal display separate permissive and absolute stop aspects. Operating rules generally dictate that a dark signal must be interpreted as displaying its most restrictive aspect (generally "Stop" or "Stop and Proceed").

E. Signal form

Signals differ both in the manner in which they display aspects and in the manner in which they are mounted with respect to the track.


(Fig2.3.Signal form)

F. Mechanical signals

Mechanical semaphore signals at Kościerzyna in Poland. A British semaphore signal on the former Southern Region of British Railways. The oldest forms of signal displayed their different indications by a part of the signal being physically moved. The earliest types comprised a board that was either turned face-on and fully visible to the driver, or rotated away so as to be practically invisible. These signals had two or at most three positions. Semaphore signals were patented in the early 1840s by Joseph James Stevens, and soon became the most widely-used form of mechanical signal, although they are now decreasing in number. The semaphore arm consists of two parts: An arm or blade which pivots at different angles, and a spectacle holding coloured lenses which move in front of a lamp in order to provide indications at night. Usually these were combined into a single frame, though in some types (e.g. "somersault" signals in which the arm pivoted in the centre), the arm was separate from the spectacle. The arm projects horizontally in its most restrictive aspect; other angles indicate less restrictive aspects. Semaphores come in "lower quadrant" and "upper quadrant" forms. In lower quadrant signals, the arm pivots down for less restrictive aspects. Upper quadrant signals, as the name implies, pivot the arm upward. Either type may be capable of showing two or three indications depending on the application. For example, it was common in the United States for train order signals to point the arm straight down to indicate "Proceed". The colour and shape of the arm is commonly varied to show the type of signal and therefore type of indication displayed. A common pattern was to use red, square-ended arms for "stop" signals and yellow "fishtail" arms for "distant" signals. A third type with a pointed end extending outward (in the opposite direction from the fishtail shape) may indicate "proceed at restricted speed after stopping" (and indeed, stopping itself is often waived for heavy freight ("tonnage") trains already moving at slow speed).The first railway semaphore was erected by Charles Hutton Gregory on the London and Croydon Railway (later the Brighton) at New Cross, southeast London, in the winter of 1842-1843 on the newly enlarged layout also accommodating the South Eastern Railway. The semaphore was afterwards rapidly adopted as a fixed signal throughout Britain, superseding all other types in most uses by 1870. Such signals were widely adopted in the U.S. after 1908.Initially, railway semaphores were mounted on the roof of the controlling signal box, but gradually a system of wires and pulleys controlled through mechanical linkages was developed to control the signals at a distance. Signal boxes became controllers of interlocking, and came to be known as interlocking towers or simply signal towers in the United States, while retaining the name "signal box" in the United Kingdom. The signals protecting the station itself came to be called home signals, while signals some distance away giving advance warning came to be called distant signals. Mechanical signals may be operated by electric motors or hydraulically. The signals are designed to be fail-safe so that if power is lost or a linkage is broken, the arm will move by gravity into the horizontal position. For lower quadrant semaphores this requires special counterweights to cause the arm to rise rather than fall; this is one of the reasons for the widespread switch to upper quadrant signals. In the U.S., semaphores were employed as train order signals, with the purpose of indicating to engineers whether they should stop to receive a telegraphed order, and also as simply one form of block signalling. Mechanical signals worldwide are being phased out in favour of colour-light signals or, in some cases, signalling systems that do not require line side signals (e.g. RETB).

(Fig2.4.Semaphore signal)

G. Colour light signals

Network Rail (UK) two-aspect colour light railway signal set at 'danger ‘The introduction of electric light bulbs made it possible to produce colour light signals which were bright enough to be seen during daylight. Many railways thus converted to colour light signals. The signal head is the portion of a colour light signal which displays the aspects. To display a larger number of indications, a single signal might have multiple signal heads. Some systems used a single head coupled with auxiliary lights to modify the basic aspect. Colour light signals come in two forms. The most prevalent form is the multi-unit type, with separate lights and lenses for each colour, in the manner of a traffic light. Hoods and shields are generally provided to shade the lights from sunlight which could cause false indications; coloured Fresnel lenses are used to focus the beam, though reflectors are often not used in order to prevent false indications from reflected sunlight. The lights may be mounted vertically or in a triangle; usually green is on top and red at the bottom. Signals with more than three aspects to display generally have multiple heads to display combinations of colours. Mechanism of a searchlight signal made by Union Switch & Signal, with the lamp and reflector removed to expose the colored roundels Searchlight signals were also used, although these have become less popular. In these, a single incandescent light bulb is used in each head, and a solenoid is used to position a colored spectacle (or 'roundel') in front of the lamp. In effect, this mechanism is very similar to the colour light signal that is included in an electrically operated semaphore signal, except that the omission of the semaphore arm allows the roundels to be miniaturized and enclosed in weather proof housing. Typically, an elliptical reflector focuses the lamp through the roundel a small lens and then a larger Fresnel lens. The viewing angle for the searchlight beam is frequently very narrow, so these signals have to be carefully sited and aligned in order for the light to be seen properly. Again, to display more than three aspects, multiple heads are used. Searchlight signals have the disadvantage of having moving parts in what can be a hostile location for mechanical equipment and thus need regular maintenance. Searchlight signals could be seen on the Colchester to Clacton line in the UK until their replacement with LED signals in 2009. A few searchlight signals remain in use at Clacton. A variant of this is the Unilens signal made by Safe ran Systems Corporation, which uses a single-lens system, fed by three or four individual halogen lamps with parabolic reflectors behind them. These lamps shine through coloured filters into individual fibre-optic elements, which join together at the focal point of the lens assembly. This makes it possible to show four different colours (usually red/yellow/green/lunar (white)) from a single signal head, which is impossible for the traditional searchlight mechanism.

(Fig2.5.Signal colours)

H. German railway signals showing aspect Hp0 (Stop*)*

More recently, clusters of LEDs have started to be used in place of the incandescent lamps, reflectors and lenses. They have a more even colour output, use less power and have a working life of around 10 years, significantly reducing long term costs. These are often arranged so that the same aperture is used for whichever colour light is required and are therefore sometimes referred to as modern searchlights. Operating rules generally dictate that a dark signal be interpreted as giving the most restrictive indication it can display (generally "stop" or "stop and proceed"). Obviously this greatly impedes traffic until repairs are made. Therefore many colour light systems have circuitry to detect failures in lamps or mechanism, allowing the signal to compensate for the failure by displaying an aspect which, while more restrictive than that set by the dispatcher or signalling equipment, still allows traffic to pass for example, if a green lamp is burned out, but the indication to be displayed is "clear", the signal can detect this and display a cautionary aspect using a different lamp or lamps, allowing traffic to proceed at reduced speeds without stopping. Approach lighting leaves the signal dark (or dimmed) when a train is not present. This may be applied for sighting reasons, or simply to extend the life of the lamp and save the batteries. In the UK, most filament-type colour light signals are equipped with lamps having two filaments. When the main filament fails, the auxiliary filament automatically comes into use. Failure of the main filament is indicated to the technician (but not the signalman), who will then arrange for the lamp to be replaced. Failure of both filaments, resulting in a 'dark' signal, is indicated to the signalman, inside the signal box, also the previous signal may also be restricted to no more than a yellow warning aspect.

I. Position light signals

A position light signal is one where the position of the lights, rather than their colour, determines the meaning. The aspect consists solely of a pattern of illuminated lights, which are the entire same colour (typically amber or white). In many countries, small position light signals are used as shunting signals, while the main signals are of colour light form. Also, many tramway systems (such as the Metro of Wolverhampton) use position light signals. On the Pennsylvania Railroad, lights were displayed in rows of three, corresponding to the positions of a semaphore blade. Multiple signal heads were used at interlocking where four aspects did not suffice. The Pennsylvania Railroad chose to use position lights to both replace the semaphores and their moving parts as well as because the intense amber light provided superior visibility in adverse weather conditions such as rain or fog. The prototype position lights used rows of 4 lamps in an asymmetric fashion in the style of semaphore blades, but this was later changed to the symmetric 3-lamp system. The first installation of 3-lamp semaphores occurred on the Main Line between Philadelphia and Paoli, in concurrence with the 1915 electrification. These first signals differed from the later ones in that the lamps were mounted separately in front of a tombstone shaped black painted metal backing. Later the lamps and backing were integrated into a single unit. The Norfolk and Western also adopted PRR type amber position lights, as the PRR had a 33% share in the N&W at the time. Furthermore, the Long Island Rail Road adopted position lights after it was bought outright by the PRR. After the Penn Central merger, the former all-amber position lights were modified with twin red lenses in the upper horizontal position to enhance recognition of Stop signals at interlocking. The N&W also modified its all-amber position lights to include colour in the 1950s, and Amtrak fully coloured its inherited position lights (replacing all the amber) starting in the 1980s.Two-head colour position signal on CSXT mainline at Savage, Maryland. The left head displays "Stop", the right head, "Clear".

J. Colour-position signals

A system combining aspects of the colour and position systems was developed on the Baltimore and Ohio Railroad in the 1920s and was also applied to the Chicago and Alton Railroad when the latter was under B&O control. The CPLs were first installed as a pilot on the Staten Island Railroad in New York City; a former B&O subsidiary later turned rapid transit line operated by the Metropolitan Transportation Authority. The B&O system used a central round head with pairs of lights mimicking the traditional semaphore positions using pairs of large coloured lights (green, yellow, red) with a lunar white also being present sometimes. The main head was surrounded by up to 6 so-called "orbitals" at the 12, 2, 4, 6, 8 and 10 o'clock positions. The function of the main head was block occupancy information with green representing 2 or clearer blocks, yellow 1 clear block and red/lunar white representing no clear blocks. The orbital's would then serve to provide speed information, 12 o'clock being full (authorized) speed, 6 being Medium speed (Limited speed if flashing), 10 being Full to Medium (Limited if flashing), 2 being Full to Slow, 8 being Medium to Medium, 4 being Medium to Slow and no lit orbital's being Slow to Slow. The B&O CPL system was, and continues to be, the most theoretically sound signalling system in North America. It is the only system of signal aspects used in North America which only displays the colour red for situations involving an obstructed block or interlocking. Also, it is the only system to use the same aspects on high signals as it does on dwarf signals. Despite its advantages in clarity and viability, due to higher maintenance and construction costs it was not adopted by other railroads, and in the 1990s and 2000s CSX was gradually replacing these signals with colour light signals, though as of 2006, clusters of them remained, especially on secondary main lines. When the Staten Island Railroad was re-signalled in 2005 the MTA decided to keep and upgrade the CPL system. The Norfolk and Western as well as Amtrak both used a system which altered former all-amber position lights to ones with coloured lenses for visibility purposes. These should not be referred to or mistaken with B&O Colour Position Lights. On Amtrak they are officially called Position Colour Light although colorized position light would also be accurate.

K. Signal mounting

A gantry of British semaphore signals seen from the cab of a steam locomotive Line side signals need to be mounted in proximity to the track which they control.

Post mounting

When a single track is involved, the signal is normally mounted on a post which displays the arm or signal head at some height above the track, in order to allow it to be seen at a distance. The signal is normally put on the engineer's or driver's side of the tracks (Fig 2.8)


(Fig2.6.Post mounting signal)

Gantry mounting

When multiple tracks are involved, or where space does not permit post mounting, other forms are found. In double track territory one may find two signals mounted side by side on a bracket which itself is mounted on a post. The left hand signal then controls the left-hand track, and the right signal the right-hand track. A gantry or signal bridge may also be used. This consists of a platform extending over the tracks; the signals are mounted on this platform over the tracks they control.

Ground mounting

Dwarf signal at Utrecht Central, Netherlands, in some situations where there is insufficient room for a post or gantry, signals may be mounted at ground level. Such signals may be physically smaller (termed dwarf signals). Rapid transit systems commonly use nothing but dwarf signals due to the restricted space. In many systems, dwarf signals are only used to display 'restrictive' aspects such as low speed or shunt aspects, and do not normally indicate 'running' aspects.

Control and operation of signals

Signals were originally controlled by levers situated at the signals, and later by levers grouped together and connected to the signal by wire cables, or pipes supported on rollers (US). Often these levers were placed in a special building, known as a signal box (UK) or interlocking tower (US), and eventually they were mechanically interlocked to prevent the display of a signal contrary to the alignment of the switch points. Automatic traffic control systems added track circuits to detect the presence of trains and alter signal aspects to reflect their presence or absence.

Cab signalling

Some locomotives are equipped to display cab signals. These can display signal indications through patterns of lights in the locomotive cab, or in simple systems merely produce an audible sound to warn the driver of a restrictive aspect. Occasionally, cab signals are used by themselves, but more commonly they are used to supplement signals placed at line side. Cab signalling is particularly useful on high speed railways. In the absence of line side signals, fixed markers may be provided at those places where signals would otherwise exist, to mark the limit of a movement authority.

Signalling power

Usually, signals and other equipment (such as track circuits and level crossing equipment), are powered from a low voltage supply (varies with country and equipment). The reason behind this is that the low voltage allows easy operation from storage batteries, and indeed in some parts of the world, batteries are the primary power source, as mains power may be unavailable at that location. In urban built-up areas, the trend is now to power signal equipment directly from mains power, with batteries only as backup.

III. CAN CONTROLLER

Controller area network (CAN or CAN-bus) is a vehicle bus standard designed to allow microcontrollers and devices to communicate with each other within a vehicle without a host computer. CAN is a message based protocol, designed specifically for automotive applications but now also used in other areas such as industrial automation and medical equipment. Development of the CAN bus started originally in 1983 at Robert Bosch GmbH. The protocol was officially released in 1986 at the Society of Automotive Engineers (SAE) congress in Detroit, Michigan. The first CAN controller chips, produced by Intel and Philips, came on the market in 1987. Bosch published the CAN 2.0 specification in 1991.CAN is one of five protocols used in the OBD-II vehicle diagnostics standard. The OBD standard is mandatory for all cars and light trucks sold in the United States since 1996, and the EOBD standard, mandatory for all petrol vehicles sold in the European Union since 2001 and all diesel vehicles since 2004.

Automotive - A modern automobile may have as many as 70 electronic control units (ECU) for various subsystems. Typically the biggest processor is the engine control unit, which is also referred to as "ECU" in the context of automobiles; others are used for transmission, airbags, antilock braking, cruise control, audio systems, windows, doors, mirror adjustment, etc. Some of these form independent subsystems, but communications among others are essential. A subsystem may need to control actuators or receive feedback from sensors. The CAN standard was devised to fill this need. The CAN bus may be used in vehicles to connect engine control unit and transmission, or (on a different bus) to connect the door locks, climate control, seat control, etc. Today the CAN bus is also used as a field bus in general automation environments; primarily due to the low cost of some CAN Controllers and processors. Bosch holds patents on the technology, and manufacturers of CAN-compatible microprocessors pay license fees to Bosch, which is normally passed on to the customer in the price of the chip. Manufacturers of products with custom ASICs or FPGAs containing CAN-compatible modules may need to pay a fee for the CAN Protocol License.

Technology

CAN is a multi-master broadcast serial bus standard for connecting electronic control units (ECUs).Each node is able to send and receive messages, but not simultaneously. A message consists primarily of an ID usually chosen to identify the message-type or sender and up to eight data bytes. It is transmitted serially onto the bus. This signal pattern is encoded in NRZ and is sensed by all nodes. The devices that are connected by a CAN network are typically sensors, actuators, and other control devices. These devices are not connected directly to the bus, but through a host processor and a CAN controller. If the bus is free, any node may begin to transmit. If two or more nodes begin sending messages at the same time, the message with the more dominant ID (which has more dominant bits, i.e., zeroes) will overwrite other nodes' less dominant IDs, so that eventually (after this arbitration on the ID) only the dominant message remains and is received by all nodes. Each node requires a host processor. The host processor decides what received messages mean and which messages it wants to transmit itself. Sensors, actuators and control devices can be connected to the host processor. CAN controller (hardware with a synchronous clock).

Receiving

The CAN controller stores received bits serially from the bus until an entire message is available, which can then be fetched by the host processor (usually after the CAN controller has triggered an interrupt).

Sending

The host processor stores it's transmit messages to a CAN controller, which transmits the bits serially onto the bus.
Transceiver (possibly integrated into the CAN controller)

Receiving

It adapts signal levels from the bus to levels that the CAN controller expects and has protective circuitry that protects the CAN controller.

Sending

It converts the transmit-bit signal received from the CAN controller into a signal that is sent onto the bus. Bit rates up to 1 Mbit/s are possible at network lengths below 40 m. Decreasing the bit rate allows longer network distances (e.g., 500 m at 125 Kbit/s).The CAN data link layer protocol is standardized in ISO 11898-1. This standard describes mainly the data link layer composed of the logical link control (LLC) sub layer and the media access control (MAC) sub layer and some aspects of the physical layer of the OSI reference model. All the other protocol layers are the network designer's choice.

Data transmission

CAN feature an automatic 'arbitration free' transmission. A CAN message that is transmitted with highest priority will 'win' the arbitration, and the node transmitting the lower priority message will sense this and back off and wait. This is achieved by CAN transmitting data through a binary model of "dominant" bits and "recessive" bits where dominant is a logical 0 and recessive is a logical 1. This means open collector, or 'wired or' physical implementation of the bus (but since dominant is 0 this is sometimes referred to as wired-AND). If one node transmits a dominant bit and another node transmits a recessive bit then the dominant bit "wins" (a logical AND between the two).
Truth tables for dominant/recessive and logical AND

- Bus state with two nodes transmitting
- Dominant recessive
- Dominant dominant dominant
- Recessive dominant recessive

Logical AND

	0	1
0	0	0
1	0	1

A. GSM

GSM (Global System for Mobile Communications: originally from Groupe Spécial Mobile) is the most popular standard for mobile telephony systems in the world. The GSM Association, its promoting industry trade organization of mobile phone carriers and manufacturers, estimates that 80% of the global mobile market uses the standard. GSM is used by over 1.5 billion people across more than 212 countries and territories. Its ubiquity enables international roaming arrangements between mobile network operators, providing subscribers the use of their phones in many parts of the world. GSM differs from its predecessor technologies in that both signalling and speech channels are digital, and thus GSM is considered a second generation (2G) mobile phone system. This also facilitates the wide-spread implementation of data communication applications into the system.

Technical details

The longest distance the GSM specification supports in practical use is 35 kilometres (22 mi). GSM-R, Global System for Mobile Communications - Railway or GSM-Railway is an international wireless communications standard for railway communication and applications. A sub-system of European Rail Traffic Management System (ERTMS), it is used for communication between train and railway regulation control centres. The system is based on GSM and EIRENE - MORANE specifications which guarantee performance at speeds up to 500 km/h (310 mph), without any communication loss. The standard is the result of over ten years of collaboration between the various European railway companies, with the goal of achieving interoperability using a single communication platform. GSM-R is part of the new European Rail Traffic Management System (ERTMS) standard and carries the signalling information directly to the train driver, enabling higher train speeds and traffic density with a high level of safety.

B. GSM-R Uses

GSM-R permits new services and applications for mobile communications in several domains:

- transmission of Long Line Public Address (LLPA) announcements to remote stations down the line
- control and protection (Automatic Train Control/ETCS) and ERTMS)
- communication between train driver and regulation center,
- communication of on-board working people
- information sending for ETCS
- communication between train stations, classification yard and rail tracks

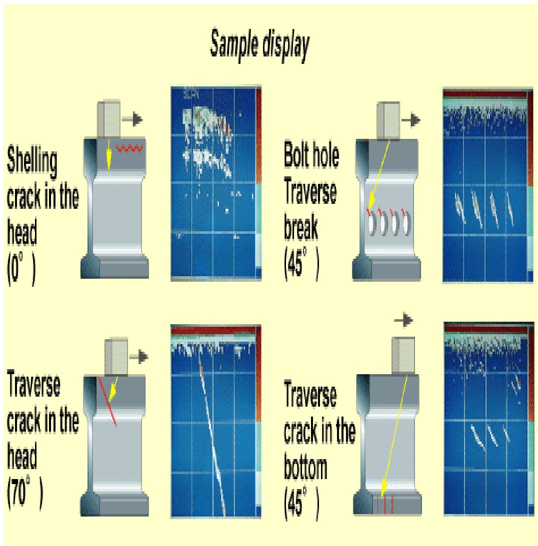
Main use

It is used to transmit data between trains and railway regulation centres with level 2 and 3 of ETCS. When the train passes over a Eurobalise, it transmits its new position and its speed, and then it receives back agreement (or disagreement) to enter the next track and its new maximum speed. In addition, trackside signals become redundant.

Railways using GSM-R

TGV POS, linking Paris to Germany and Switzerland ICE 3M at Gare de Est in Paris. A fully-functional GSM-R system is being trailed on the North Clyde Line in Scotland from 2007. For some years before these trials commenced however, GSM-R has been in use for voice-only purposes (known as the 'Interim Voice Radio System' (IVRS)) in some locations where axle counters are used for train detection, for example parts of the West Coast Main Line (WCML) between Crewe and Wembley. Britain's GSM-R network should be fully operational by 2013 at a cost of £1.2 billion. This cost though does not include the WCML.The first train (390 034 on the 09.15 Manchester Piccadilly service to London Euston) to use GSM-R on the south end of the West Coast Main Line ran on 27 May 2009. This is the first vehicle to run in passenger service with GSM-R outside of the Strathclyde trial. On 2nd Sept 09 the Rugby to Stoke section went live. Network Rail has fitted out a test train at Derby it purchased for RSV testing of the GSM-R network. The train is formed from ex Gatwick Express stock. At a cost of £5.9 million, this custom-built machine known as the RSV (Radio Signal Verification) train, has already started monitoring the Newport Synergy scheme and the Cambrian Line. The Cambrian Line ERTMSPwllheli to HarlechRehearsal commenced on 13 February 2010 and successfully finished on 18 February 2010. The driver familiarisation and practical handling stage of the Rehearsal has provided an excellent opportunity to monitor the use of GSM-R voice in operation on this route. The first train departed Pwllheli at 0853hrs in ERTMS Level 2 Operation with GSM-R voice being used as the only means of communication between the driver and the signaller. In France, the first commercial railway route opened with full GSM-R coverage is the LGV Esteuropenne linking Paris Gare de l'Est to Strasbourg. It was opened on the 10th of June 2007.On Sunday, June 10, 2007 at 0643, the first high speed train run on it was the ICE, the high speed train from the German passenger operator: DB. It linked the Gare de l'Est in Paris to Saarbrucken (Germany).On the same day, 0715; it was the opportunity of the TGV POS, the last generation high speed train from the French operator, SNCF. It linked Strasbourg to Paris (Gare de l'Est).In Norway, the GSM-R network was opened on all lines on 1 January 2007.In The Netherlands, there is coverage on all the lines and the old system called Telerail was abandoned in favour of GSM-R in 2006.As of 2008, in Italy more than 9000 km of railway lines are served by the GSM-R infrastructure: this number includes both ordinary and high speed lines, as well as more than 1000 km of tunnels. Roaming agreements with other Italian mobile operators allow coverage of line.

C. Types of Detects



(Fig3.1.Types of detection in cracks)

Types of Corrosion and its Prevention

There are different types of corrosion. Appropriate reasons are described. Corrosion is a natural phenomenon. Eminent scientists, engineers, and researchers have been successful over the years in overcoming this menacing problem. Nevertheless, periodical assessments are done to achieve the current level of protection.

Galvanic Corrosion

Gradual decay of metal by electrochemical process or by chemical is corrosion. Galvanic corrosion is a generic form. An anode, cathode and an electrolyte are necessary to form galvanic corrosion. This combination is known as a galvanic cell. It is formed when two dissimilar metals are electrically connected by an aqueous solution that causes electron transfer. Chemical reduction forms when the current enters the electrode from the electrolyte. Electrical potential difference occurs when anode and cathode are separated in a conductive electrolyte. The charged cat-ions flow from anode to cathode via a conductive electrolyte. An electrical circuit is formed by this action, and corrosion occurs at the anode. The cathode may corrode to a lesser extent. Oxidation happens when anode loses electrons, which causes a positively charged metal surface. Cat-ions attract negative anions in electrolyte forming a new compound. It loses its former metal properties forming rust or iron oxide. Reduction refers to the gain of electrons at the cathode. Thus the cathode retains its metallic properties. The occurrence and magnitude of corrosion depends on the potential difference between anode and cathode. Metals of highest potentials generally appear at the anodic end of the galvanic series and those with lowest potentials are at the cathodic end of the galvanic series. As a general rule, metals at the farther end of the galvanic series are more susceptible to corrosion when put together in a solution. Galvanic corrosion is invariably due to an electrochemical process wherein incompatible metals are connected to an electrical field through an electrolyte. Non-compatible metals – examples are aluminium and copper and aluminium and iron. Aluminium has a high affinity with oxygen. It instantly forms a tough oxide film which retards further oxidation.Aluminum and steel components are protected by powder coating. They come with attractive colours and a thick coating gives long lasting protection from corrosion. If the coating is scratched, corrosion starts gradually peeling the coating.

Intergranular Corrosion

Oxides at grain boundaries have high electrical resistance. Mechanical properties are also affected. The yield strength declines. Cold working suffers damage. Microstructure study reveals spread and agglomerated distribution of unwanted oxides. Aluminium oxides always settle at grain boundary which is unavoidable. Aircrafts use aluminium alloys. Treating the molten alloys or pure aluminium with rare earth elements contains the oxides inside the grain boundaries. It makes the metal stronger and electrically efficient. Fatigue failures are avoided by containing oxides inside the grain boundaries.

Uniform Corrosion

All types of corrosion are generally correlated though they may take different forms. Corrosion may spread over uniformly or concentrated at a localized area. This is distinguished by uniformity of corrosion distribution caused by movement of anodic and cathodic areas of the metallic surfaces. This tendency is more precarious than a failure case. The uniform spread of corrosion is usually seen at the base of railway track is a classic example. The track is of I section and it is mechanically strong. Failures do not happen at the base since it is always under compressive loads. It makes no difference whether it is electric engine or diesel engine. Fatigue failure happens only at the joint interface under tensile stress.

Localized Corrosion

Localized corrosion creates tiny holes or pits in the metal surface. It is most dangerous like small pox. These pits are known as pitting effect. These are not readily visible. They may be concealed by corrosion debris. The dangerous subsurface damage gives rise to fatigue cracks if the metal is under tensile stress. Fortunately, pitting on the railway track is not serious problem because the high compressive rolling force does not allow pits to happen. This action is like shot blasting effect. The track faces are always shiny when there is constant traffic.

Stress Corrosion

Combinations of corrosive conditions under the application of tensile stress which have lower yield strength are prime reasons for failure. It is a time-based failure tendency.

Hydrogen Embrittlement

Whenever hydrogen gas is absorbed by metals at lower temperatures, the metals are susceptible to brittleness.

Passivation

Electroplated steel parts with zinc plating are passivated to prevent corrosion. After zinc plating is done with a zinc coat thickness of few microns, the component is dipped into chromic acid solution for a few seconds. It is rinsed in water and dried immediately to remove water traces. The surface attains a bright golden yellow colour finish which lasts in long use. Hot drying is done with temperature controlled electrically heated air blower. Please note that hot air temperature should not exceed 600C. If done at higher temperature, the attractive surface finish loses its luster and eventually becomes pretty dull. This is because the required bright finish which is a zinc chromate surface becomes zinc chromite. Zinc chromite and zinc chromate can be easily detected by X ray Diffraction analysis. Zinc chromite surface fades fast and becomes patchy with rust formation.

Anodizing

Aluminium has natural surface oxide protection. Increasing this oxide layer is known as anodizing. In anodizing, aluminium parts are connected to an electrode and the electrolyte is sulphuric acid. This gives higher corrosion and wears resistance. It has a crystalline structure surface and its thermal conductivity is less than aluminium. If the anodized parts are subjected to temperatures beyond 700C the surface layer will crack due to thermal stress. The thick anodized aluminium oxide layer with powder coating provides electrical protection against lighting- particularly for airplanes.

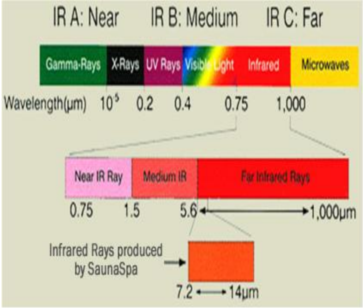
Powder Coating

Cleaned metal parts free from oil and grease are passivated with chromates or phosphates and powder coated with colour powder with an electrostatic gun. Passivating improves bonding. Powder coating comes in different attractive colours, and it has a lasting aesthetic appeal.

IV Avoidance Of Collision

A. IR Rays

Infrared (IR) light is electromagnetic radiation with a wavelength between 0.7 and 300 micrometres, which equates to a frequency range between approximately 1 and 430 THz.IR wavelengths are longer than that of visible light, but shorter than that of terahertz radiation microwaves. Bright sunlight provides an irradiance of just over 1 kilowatt per square meter at sea level. Of this energy, 527 watts is infrared radiation, 445 watts is visible light, and 32 watts is ultraviolet radiation.



(Fig4.1.IR rays)

Different regions in the infrared

Objects generally emit infrared radiation across a spectrum of wavelengths, but only a specific region of the spectrum is of interest because sensors are usually designed only to collect radiation within a specific bandwidth. As a result, the infrared band is often subdivided into smaller sections.

CIE division scheme

The International Commission on Illumination (CIE) recommended the division of infrared radiation into the following three bands:

IR-A: 700 nm–1400 nm (0.7 µm – 1.4 µm)
IR-B: 1400 nm–3000 nm (1.4 µm – 3 µm)
IR-C: 3000 nm–1 mm (3 µm – 1000 µm)
A commonly used sub-division scheme is:

Near-infrared (NIR, IR-A DIN)

0.75-1.4 µm in wavelength, defined by the water absorption, and commonly used in fiber optic telecommunication because of low attenuation losses in the SiO2 glass (silica) medium. Image intensifiers are sensitive to this area of the spectrum. Examples include night vision devices such as night vision goggles.

Short-wavelength infrared (SWIR, IR-B DIN)

1.4-3 µm, water absorption increases significantly at 1,450 nm. The 1,530 to 1,560 nm range is the dominant spectral region for long-distance telecommunications.

Mid-wavelength infrared (MWIR, IR-C DIN) also called intermediate infrared (IIR)

3-8µm. In guided missile technology the 3-5 µm portion of this band is the atmospheric window in which the homing heads of passive IR 'heat seeking' missiles are designed to work, homing on to the IR signature of the target aircraft, typically the jet engine exhaust plume.

Long-wavelength infrared (LWIR, IR-C DIN)

8–15µm. This is the "thermal imaging" region, in which sensors can obtain a completely passive picture of the outside world based on thermal emissions only and requiring no external light or thermal source such as the sun, moon or infrared illuminator. Forward-looking infrared (FLIR) systems use this area of the spectrum. Sometimes also called the "far infrared."

Far infrared (FIR) 15 - 1,000 µm (see also far infrared laser):

NIR and SWIR is sometimes called "reflected infrared" while MWIR and LWIR is sometimes referred to as "thermal infrared." Due to the nature of the blackbody radiation curves, typical 'hot' objects, such as exhaust pipes, often appear brighter in the MW compared to the same object viewed in the LW.

ISO 20473 scheme

Designation	Abbreviation	Wavelength
Near Infrared	NIR	0.78 - 3 µm
Mid Infrared	MIR	3 - 50 µm
Far Infrared	FIR	50 - 1000 µm

Astronomy division scheme

Astronomers typically divide the infrared spectrum as follows

Designation	Abbreviation	Wavelength
Near Infrared	NIR	(0.7-1) to 5 µm
Mid Infrared	MIR	5 to (25-40) µm
Far Infrared	FIR	(25-40)to(200-350) µm.

These divisions are not precise and can vary depending on the publication. The three regions are used for observation of different temperature ranges, and hence different environments in space.

B. Communications

IR data transmission is also employed in short-range communication among computer peripherals and personal digital assistants. These devices usually conform to standards published by IrDA, the Infrared Data Association. Remote controls and IrDA devices use infrared light emitting diodes (LEDs) to emit infrared radiation which is focused by a plastic lens into a narrow beam. The beam is modulated, i.e. switched on and off, to encode the data. The receiver uses a silicon photodiode to convert the infrared radiation to an electric current. It responds only to the rapidly pulsing signal created by the transmitter, and filters out slowly changing infrared radiation from ambient light. Infrared communications are useful for indoor use in areas of high population density. IR does not penetrate walls and so does not interfere with other devices in adjoining rooms. Infrared is the most common way for remote controls to command appliances. Free space optical communication using infrared lasers can be a relatively inexpensive way to install a communications link in an urban area operating at up to 4 gigabit/s, compared to the cost of burying fibre optic cable. Infrared lasers are used to provide the light for optical fiber communications systems. Infrared light with a wavelength around 1,330 nm (least dispersion) or 1,550 nm (best transmission) are the best choices for standard silica fibers.IR data transmission of encoded audio versions of printed signs is being researched as an aid for visually impaired people through the RIAS (Remote Infrared Audible Signage) project.

C. Transmitted Rays

In optics, a ray is an idealized narrow beam of light. Rays are used to model the propagation of light through an optical system, by dividing the real light field up into discrete rays that can be computationally propagated through the system by the techniques of ray tracing. This allows even very complex optical systems to be analyzed mathematically or simulated by computer. Ray tracing uses approximate solutions to Maxwell's equations that are valid as long as the light waves propagate through and around objects whose dimensions are much greater than the light's wavelength. Ray theory does not describe phenomena such as interference and diffraction, which require wave theory (involving the phase of the wave).

Special rays

There are many special rays that are used in optical modelling to analyze an optical system. These are defined and described below, grouped by the type of system they are used to model. Interaction with surfaces, Diagram of rays at a surface, an incident ray is a ray of light that strikes a surface. The angle between this ray and the perpendicular or normal to the surface is the angle of incidence. The reflected ray corresponding to a given incident ray, is the ray that represents the light reflected by the surface. The angle between the surface normal and the reflected ray is known as the angle of reflection. The Law of Reflection says that for a specular (non-scattering) surface, the angle of reflection always equals the angle of incidence. The refracted ray or transmitted ray corresponding to a given incident ray represents the light that is transmitted through the surface. The angle between this ray and the normal is known as the angle of refraction, and it is given by Snell's Law. Conservation of energy requires that the power in the incident ray must equal the sum of the power in the transmitted ray, the power in the reflected ray, and any power absorbed at the surface. If the material is birefringent, the refracted ray may split into ordinary and extraordinary rays, which experience different indexes of refraction when passing through the birefringent material.

D. Reflected Rays

In optics, a ray is an idealized narrow beam of light. Rays are used to model the propagation of light through an optical system, by dividing the real light field up into discrete rays that can be computationally propagated through the system by the techniques of ray tracing. This allows even very complex optical systems to be analyzed mathematically or simulated by computer. Ray tracing uses approximate solutions to Maxwell's equations that are valid as long as the light waves propagate through and around objects whose dimensions are much greater than the light's wavelength. Ray theory does not describe phenomena such as interference and diffraction, which require wave theory (involving the phase of the wave).

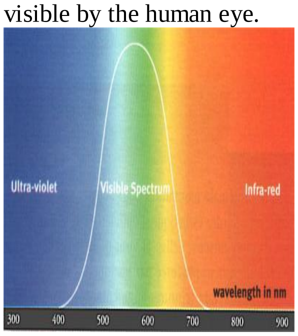
E. Time and Distance Calculation

The Time and distance can be calculated by using the following ways.
If energy get waste means,

Incident rays = reflected rays.
If energy get now waste means,
Incident rays =/ reflected rays.
From the rays we can calculate the distance from the calculated distance we can set the time.

V UV & IR RAYS SENSING

Almost everything emits, reflects, or transmits some kind of light. The Electromagnetic (EM) Spectrum is the measurement of the frequency range of EM radiation of an object. The frequency is measured in wavelengths. The wavelength ranges can extend from the size of an atom to thousands of kilometres. The long wavelengths are low frequency and are the Radio, Microwave, and Infrared waves. The short wavelengths are the high frequency Ultraviolet, X-ray and Gamma Rays. The Visible Spectrum, or Optical Spectrum, is the range of the Electromagnetic Spectrum that is visible by the human eye.



(Fig5.1.spectrum waves)

A. Electromagnetic Spectrum

The Visible Spectrum has no clear boundaries from one colour to the next but is generally described in the following ranges:

- Violet 380-450nm (nanometres)
- Blue 450-495nm
- Green 495-570nm
- Yellow 570-590nm
- Orange 590-620nm
- Red 620-750nm

B. CAN CONTORLLER TO GSM INTERFACING

The base station subsystem (BSS) is the section of a traditional cellular telephone network which is responsible for handling traffic and signalling between a mobile phone and the network switching subsystem. The BSS carries out transcoding of speech channels, allocation of radio channels to mobile phones, paging, transmission and reception over the air interface and many other tasks related to the radio network.

Base transceiver station

Two GSM base station antennas disguised as trees in Dublin, Ireland. A solar-powered GSM base station on top of a mountain in the wilderness of Lapland

Base transceiver station

The base transceiver station, or BTS, contains the equipment for transmitting and receiving radio signals (transceivers), antennas, and equipment for encrypting and decrypting communications with the base station controller (BSC). Typically a BTS for anything other than a picocell will have several transceivers (TRXs) which allow it to serve several different frequencies and different sectors of the cell (in the case of sectorised base stations).A BTS is controlled by a parent BSC via the "base station control function" (BCF). The BCF is implemented as a discrete unit or even incorporated in a TRX in compact base stations. The BCF provides an operations and maintenance (O&M) connection to the network management system (NMS), and manages operational states of each TRX, as well as software handling and alarm collection. The functions of a BTS vary depending on the cellular technology used and the cellular telephone provider. There are vendors in which the BTS is a plain transceiver which receives information from the MS (mobile station) through the Um (air interface) and then converts it to a TDM (PCM) based interface, the Abis interface, and sends it towards the BSC. There are vendors which build their BTSs so the information is pre-processed, target cell lists are generated and even intracellular handover (HO) can be fully handled. The advantage in this case is fewer loads on the expensive Abis interface. The BTSs are equipped with radios that are able to modulate layer 1 of interface Um; for GSM 2G+ the modulation type is GMSK, while for EDGE-enabled networks it is GMSK and 8-PSK.Antenna combiners are implemented to use the same antenna for several TRXs (carriers), the more TRXs are combined the greater the combiner loss will be. Up to 8:1 combiners are found in micro and Pico cells only. Frequency hopping is often used to increase overall BTS performance; this involves the rapid switching of voice traffic between TRXs in a sector. A hopping sequence is followed by the TRXs and handsets using the sector. Several hopping sequences are available, and the sequence in use for a particular cell is continually broadcast by that cell so that it is known to the handsets. A TRX transmits and receives according to the GSM standards, which specify eight TDMA timeslots per radio frequency. A TRX may lose some of this capacity as some information is required to be broadcast to handsets in the area that the BTS serves. This information allows the handsets to identify the network and gain access to it. This signalling makes use of a channel known as the broadcast control channel (BCCH).

Sectorisation: Sector antenna

By using directional antennae on a base station, each pointing in different directions, it is possible to sectorise the base station so that several different cells are served from the same location. Typically these directional antennas have a beam width of 65 to 85 degrees. This increases the traffic capacity of the base station (each frequency can carry eight voice channels) whilst not greatly increasing the interference caused to neighbouring cells (in any given direction, only a small number of frequencies are being broadcast). Typically two antennas are used per sector, at spacing of ten or more wavelengths apart. This allows the operator to overcome the effects of fading due to physical phenomena such as multipath reception. Some amplification of the received signal as it leaves the antenna is often used to preserve the balance between uplink and downlink signal

Base station controller

GSM transmitter

The base station controller (BSC) provides, classically, the intelligence behind the BTSs. Typically a BSC has tens or even hundreds of BTSs under its control. The BSC handles allocation of radio channels, receives measurements from the mobile phones, and controls handovers from BTS to BTS (except in the case of an inter-BSC handover in which case control is in part the responsibility of the anchor MSC). A key function of the BSC is to act as a concentrator where many different low capacity connections to BTSs (with relatively low utilisation) become reduced to a smaller number of connections towards the mobile switching centre (MSC) (with a high level of utilisation). Overall, this means that networks are often structured to have many BSCs distributed into regions near their BTSs which are then connected to large centralised MSC sites.

The BSC is undoubtedly the most robust element in the BSS as it is not only a BTS controller but, for some vendors, a full switching centre, as well as an SS7 node with connections to the MSC and serving GPRS support node (SGSN) (when using GPRS). It also provides all the required data to the operation support subsystem (OSS) as well as to the performance measuring centres BSC is often based on a distributed computing architecture, with redundancy applied to critical functional units to ensure availability in the event of fault conditions. Redundancy often extends beyond the BSC equipment itself and is commonly used in the power supplies and in the transmission equipment providing the Ater interface to PCU. The databases for all the sites, including information such as carrier frequencies, frequency hopping lists, power reduction levels, receiving levels for cell border calculation, are stored in the BSC. This data is obtained directly from radio planning engineering which involves modelling of the signal propagation as well as traffic projections.

Transcoder

The transcoder is responsible for transcoding the voice channel coding between the coding used in the mobile network, and the coding used by the world's terrestrial circuit-switched network, the Public Switched Telephone Network. Specifically, GSM uses a regular pulse excited-long term prediction (RPE-LTP) coder for voice data between the mobile device and the BSS, but pulse code modulation (A-law or μ-law standardized in ITU G.711) upstream of the BSS. RPE-LPC coding results in a data rate for voice of 13 kbit/s where standard PCM coding results in 64 kbit/s. Because of this change in data rate for the same voice call, the transcoder also has a buffering function so that PCM 8-bit words can be recoded to construct GSM 20 ms traffic blocks. Although transcoding (compressing/decompressing) functionality is defined as a base station function by the relevant standards, there are several vendors which have implemented the solution outside of the BSC. Some vendors have implemented it in a stand-alone rack using a proprietary interface. In Siemens' and Nokia's architecture, the transcoder is an identifiable separate sub-system which will normally be co-located with the MSC. In some of Ericsson's systems it is integrated to the MSC rather than the BSC. The reason for these designs is that if the compression of voice channels is done at the site of the MSC, the number of fixed transmission links between the BSS and MSC can be reduced, decreasing network infrastructure costs. This subsystem is also referred to as the transcoder and rate adaptation unit (TRAU). Some networks use 32 kbit/s ADPCM on the terrestrial side of the network instead of 64 kbit/s PCM and the TRAU converts accordingly. When the traffic is not voice but data such as fax or email, the TRAU enables its rate adaptation unit function to give compatibility between the BSS and MSC data rates.

Packet control unit

The packet control unit (PCU) is a late addition to the GSM standard. It performs some of the processing tasks of the BSC, but for packet data. The allocation of channels between voice and data is controlled by the base station, but once a channel is allocated to the PCU, the PCU takes full control over that channel. The PCU can be built into the base station, built into the BSC or even, in some proposed architectures, it can be at the SGSN site. In most of the cases, the PCU is a separate node communicating extensively with the BSC on the radio side and the SGSN on the GB side.

BSS interfaces

Image of the GSM network, showing the BSS interfaces to the MS, NSS and GPRS Core Network

UM

The air interface between the mobile station (MS) and the BTS.

ABIS

The interface between the BTS and BSC. Generally carried by a DS-1, ES-1, or E1 TDM circuit.

ATER

The interface between the BSC and transcoder. It is a proprietary interface whose name depends on the vendor (for example Ater by Nokia), it carries the A interface information from the BSC leaving it untouched.

GB

Connects the BSS to the SGSN in the GPRS core network.

VI NATURE OF WORK

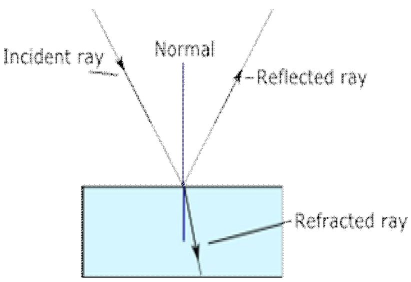
Here we are going to discuss about the proposed model for Detection and Avoidance of collision in the railway network. The detection can be done by UV rays i.e., UV transmitter & UV receiver. Avoidance can be done by the IR rays.

A. Detection of Cracks

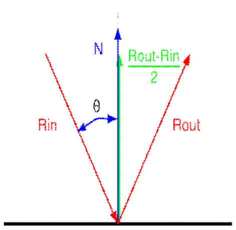
The detection of Cracks can be identified using UV rays with the UV transmitter and UV receiver. UV receiver is connected to the Signal Lamp and it will acts as Sensor. CAN controller is connected to the main node and it sends the information via GSM and transmit the message to engine and to the nearest station.

B. Avoidance of Collision

The avoidance of collision can be carried out by the IR rays. For example the two trains at different destinations i.e., from Tambaram to Chengalpattu in case two train start at different direction one train goes to Tambaram another for Chengalpattu but there is one single line so in this case severe clash will happen. In order to avoid this, our proposed model will save the train. Here we are going to pass the IR rays from the engine likewise opposite train engine also have the same rays at one particular distance the two rays will get collide and get reflected back to the engines so the alarm detects in the engine and driver will stop the train.



(Fig6.1.Rays incident on medium)



(Fig6.2.Reflected rays)

VII. RESULTS AND DISCUSSIONS

The main result for this paper is to avoid the detection of cracks and avoidance of collision between the rails. A collision avoidance technique based on short-distance train-to-train transmission is under test at the Wegberg-Wildenrath test centre near Düsseldorf in Gernamy.The trials are being led by aerospace research agency Deutches Zentrum für Luft- und Raumfahrt (DLR), which is providing researchers from its institutes for transportation systems and robotics & mechatronics. DLR partnered with train operator Bayerischen Oberlandbahn (BOB) for the trials – BOB offered use of an Integral dmu and crew. The other vehicle used was DLR's own "Rail Drive" road-rail unit.

(Fig7.1Detection of cracks)

"RCAS is a system for preventing train collisions that operates independently of other safety technology deployed alongside the railway track", Professor Dr Thomas String, project director at DLR explains. The DLR researchers delivered lectures and showed models to participants during a day of demonstration on 11 May. Observers were able to travel on the Integral, which was equipped with RCAS to communicate with the road-rail vehicle.

The two trains simulated three scenarios:

- One where the two were running alongside each other, simultaneously approaching a section of single-track line.
- In the second, one train headed for a set of points beyond which one route was occupied and the other clear, but the setting of the points was unclear.
- In a third test run, a train was left stationary near a set of points but did not constitute a hazard, and the system successfully recognised this. In all cases, RCAS assesses the situation automatically.

If it detects a conflicting move, the RCAS onboard interface prompts the driver to apply the brakes. "RCAS is initially intended for routes and situations where, at present, no other protection systems are employed – for example, routes with very low volumes of traffic, industrial railways, construction sites or shunting areas", according to Dr Michael

Meyer zu Hörste, a DLR rail transport researcher. RCAS is in no way intended to replace ERTMS, he added. "It is an add-on system – RCAS can act as a safety overlay in places where conventional technology is not being employed."According to DLR, the existing prototype is based on "standard commercial hardware and software", which in its existing form does not hold official approval for safety-critical fields of operation, and this will not be sought. In order to avoid these types of cracks we are used the proposed model of UV rays with CAN controller. Anyway, the presented results, which also can be considered as preliminary results, are very encouraging and they suggest the possibility of increasing and generalizing the UV rays set up, i.e., UV transmitter & receiver.

CONCLUSION

Our proposed model is facing a new challenge to further improve the reliability of rail testing techniques, while seeking for new and emerging technologies in UV and IR rays or that aid the detection of rail defects. With the UV rays test equipment, focus has been on better understanding of the UV receiver at the signal lamp and the interaction of with the can controller with the defects through the main CAN node to the GSM. Further results, such as the crack location, depth, type etc. can be deduced through the analysis of the GSM Ongoing work is under way to develop improved automated rail testing techniques, mostly in the field of employing the proposed model for detection of cracks. Development of new processing algorithms (e.g. pattern/signature recognition) to detect defects has become the major focus of most research activities to detect defects quickly and reliably, aiming to reduce the incidents of false alarms. In most cases, data recording capability of the rail testing equipment allows the inspector to download the data for off-line signal analysis. But our concept is mainly to detects the cracks and avoid the collision in the tracks both will be carried out successfully.

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