ISSN2394-3777 (Print)
ISSN2394-3785 (Online)
Available online atwww.ijartet.com
International Journal of Advanced Research Trends in Engineering and Technology
(IJARTET) Vol. 5, Special Issue 14, April 2018

Railway Track Crack and Obstacle Detector

Reports the continuity of Railway Track and ranges the crack

Kadripathi K.N
Dept. of Aerospace Engineering.
IIAEM (International Institute of Aerospace Engineering and Management),
Jain University, Ramanagara, Karnataka, India.
kadripathi.knk@gmail.

L.Yethinder Ragav
Dept. of Aerospace Engineering.
IIAEM (International Institute of Aerospace Engineering and Management),
Jain University, Ramanagara, Karnataka, India.
yethinder@gmail.com

ABSTRACT

India has the world's fourth largest railway networks, which carry out most of the commercial transport in India. The train transportation increased due to high speed, economical, environment friendly, safety and modern characteristics of railway system. Major problem with this transportation is the bad weather condition, which cause flaws and cracks leads to the damage of railway tracks. This is difficult to determine manually hence the solution is provided here. For reducing the derailments, the crack detection systems were designed using Ultrasonic Ranging Techniques. This paper introduces the detection of cracks in rail road's using ultrasonic transmitter and receiver. This system mainly focus to check the continuity of the railway track, if discontinuous reports the exact location of discontinuity to the nearest railway station, using GPS and GSM system. From this method we can also predict the foreign objects like rock, animals, trees or landslides that block the railway route and information is sent to the concerned authority, stating that some foreign object is detected between those two sensor points, this can be further examined using drones or real time satellite imaging. Ultimately this method is useful to determine, whether the railway route is suitable to travel at that instant of time or not.

Keywords— crack detection system, Ultrasonic Ranging Techniques, the continuity of the railway track.

I. INTRODUCTION

In India, railway network is the main mode of transportation. Due to long term usage, bad weather condition, antisocial activities (Naxalism) there are chances of damage to these network. This results in the large scale destruction of life and property. There are different types of cracks identified in the railway tracks. These effects include bending and shear stresses, wheel/rail contact stresses, thermal stresses, residual stresses and dynamic effects. Recent analysis of the factors that cause the rail accidents reveals, about 90% of railway accidents are due to cracks on the rails either due to natural causes (like excessive expansion due to heat) or due to antisocial elements. At present railways are using manual methods of crack detection through human inspectors. Manual detection is nearly unreliable and impossible in bad weather condition, remote and inaccessible locations. This proposal aims to automate this fault and crack detection process by making use of US waves (Ultrasonic waves), propagating through the length of the track, enabling the detection of cracks on railway tracks. If any crack is found, this system reports the exact location of discontinuity or crack to the nearest railway station, using GPS and GSM technique. This is discussed under topic "Crake or break ranging and detection system". Another cause for railway accidents is the collision with the foreign objects that block the railway route. This system also predicts the foreign objects that might be responsible for accident. This is discussed under the topic "Foreign object detection system"

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II. Structure of the Railway Track

Before we start with the method it is necessary to know the structure and design of the Railway Track.

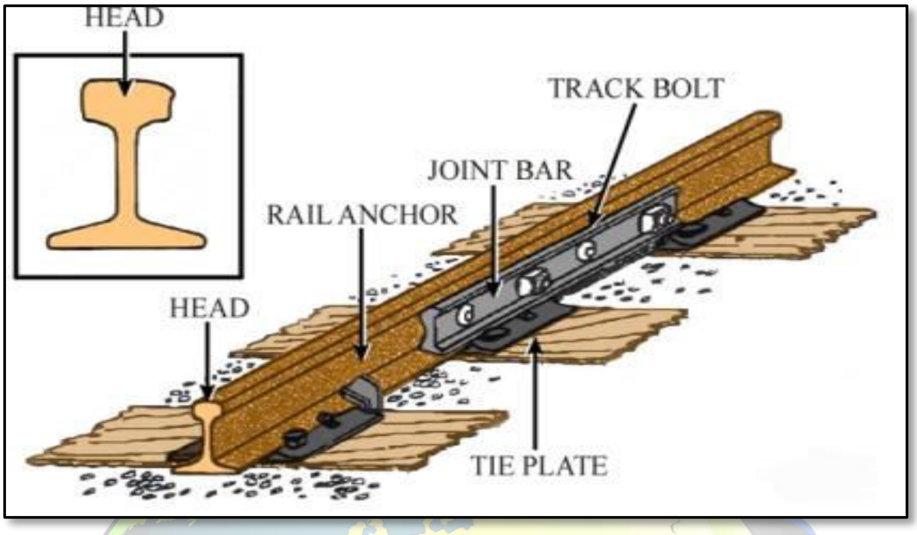

Figure 1. Structure of railway Track

Structure of railway track consists of individual rail tracks about 121 meters long (Jindal Steels), joined one after the other by joint bars to form a long loop. In-between those to individual rail tracks a small gap is given to facilitate the expansion due to linear thermal expansion. This structure is anchorage to the basement concrete blocks with a help of rail anchor as shown in Fig 1. It enables trains to move by providing a dependable surface for their wheels to roll upon. Even though there is a small gap between the two individual segments of rail, the joint bar facilitates the flow of US waves through them and establishes a continuous path for the flow of US waves. If there is any break or cracks in the track, then only it hinders the flow of US waves.

III. Proposed method

A. *Equipments required for this method*

- Transducers: Transducers are the probes that are capable of both transmitting and receiving the US waves. These probes are installed on the track (which doesn't affect the movement of train) at definite interval of distance along the track.
- GPS module: GPS modules are included in the Transducers so that we can trace the exact location of the transducer which is fixed on the railway track.
- GSM module: GSM module is a network of mobile phones (notification receiving devices), which receives the data of the location of abnormality on the track by GPS module.
- Wireless network: A wireless network has to be established in order to synchronize the work of the above components effectively.
- Centralized server: Centralized server should be established in order to control and monitor the flow of data.

B. *Design Implimentation*

Transducers are installed along the railway tracks with definite interval of distance (one transducer per 10 kilometers); working procedure of a single segment between the two transducer is discussed using Fig 2.

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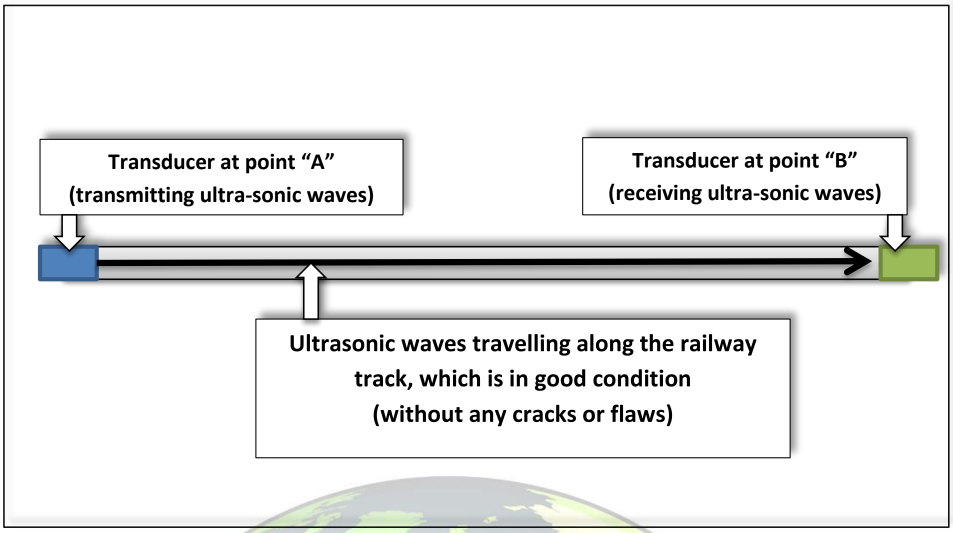

Figure 2. Recording the parameters when the track is in good condition

Initially transducer at a point A starts producing US waves of a fixed frequency and intensity. They travel along the railway track since it is continuous. Here railway track acts as a solid medium for a propagation of US waves. When it starts travelling along the track, it gradually tends to lose its initial intensity. Because there will be some absorption of these waves by the railway track, hence there will be attenuation in the US waves that are received by the transducer at a point B. These parameters (amount of attenuation, temperature... etc.) are recorded for a track that is in good condition. Further these parameters are used as a standard reference. What we have discussed here is about a single segment, like this one has to check and record the parameters for each segment (points with a distance of 10 kilometers) and condense the data of that particular route (way between one station to another station). If we analyze the graph of these parameters, we will get the below fig 3.

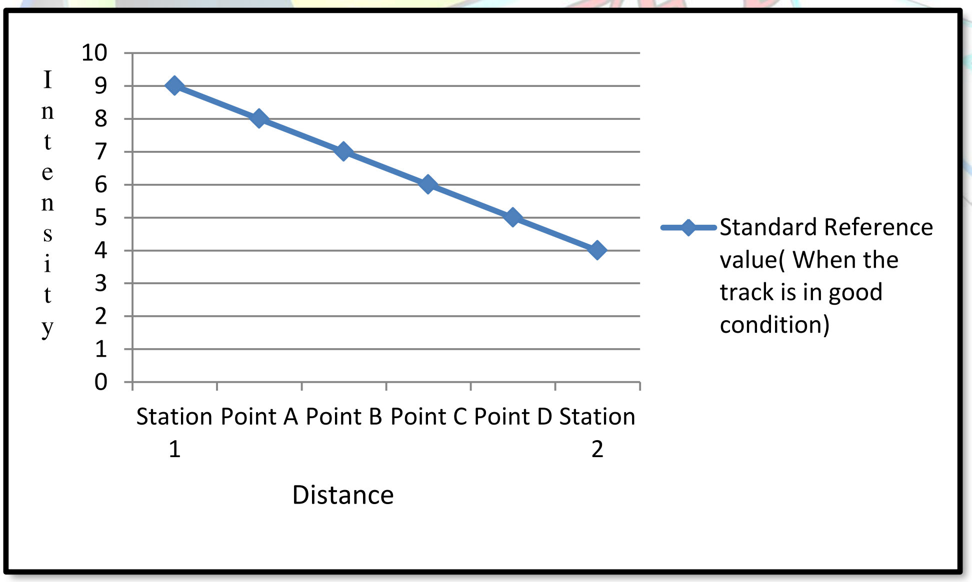

Figure 3. The distribution of parameter from point to point in between the two railway station.

We need not to perform this manually, once the US waves are produced in the transducer that is installed in the station 1. Wave starts travelling along the track, it is sensed by the transducer that is installed at the particular points they reports the intensity of the received waves and the location of the transducer to the centralized server through GSM and wireless network. Then the server analyses the parameters at every point

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(compares the real time available data to the standard reference data). That means we are comparing the condition of that track at that instant of time to the track which was in good condition earlier. If the real time parameters are matching to the standard reference parameters, then the server notifies that, the track is in good condition for a safe journey. If the real time parameters are not matching to the standard reference parameters, then there might be chances of crack developed or any foreign object detected in between the two points. Method of ranging (detecting the location) these abnormalities are discussed below with the help of different case study.

I. Crake or break ranging and detection system

When the server encounters the unexpected change in parameters between the two points when compared to standard reference value, it will check the below possible cases.

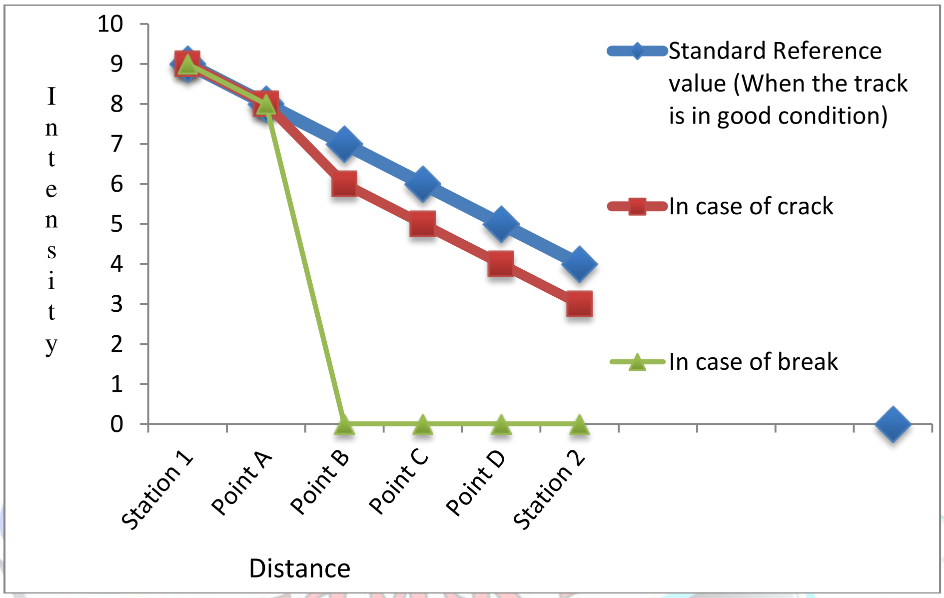

Figure 4. Graph obtained under different cases and compared with standard reference value.

A. *When crack is developed*

When the crack is developed in between two points A and B, from the graph (tabulated by real time data) we can see the sudden deviation in the parameters between those two points when compared to the standard reference value. So that we can confirm that there is something abnormality found between these two points, ranging this crack will be discussed in the topic "Ranging Technique"

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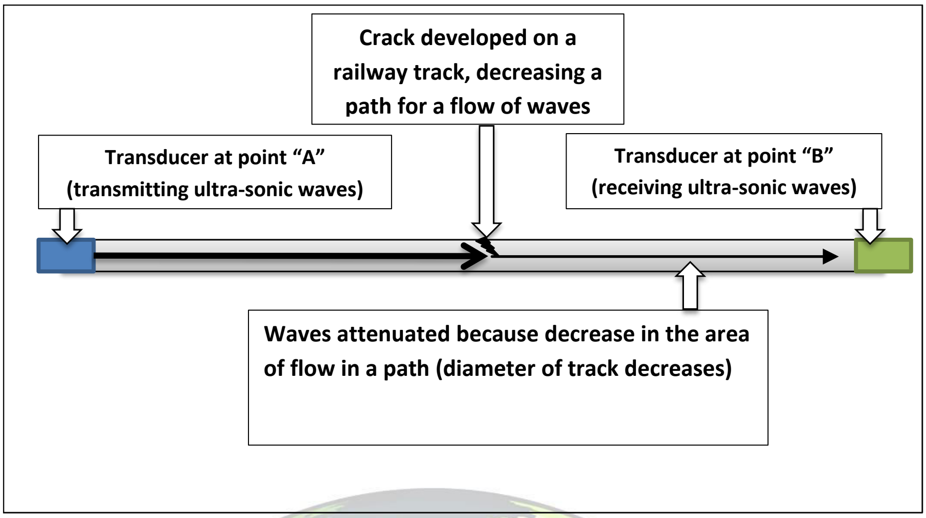

Figure 5.US Waves attenuating at crack is found

When the crack is developed on the railway track, the path for a flow of US waves decreases, hence there will be decrease in the intensity of the waves received by the transducer at point B. remaining amount of wave is reflected back to the transducer at point A. This data is sent to the centralized server for analyses.

A. When breakage is developed

When the breakage is developed in between two points A and B, from the graph (tabulated by real time data) we can see that transducer at a point B is not able to receive any wave that is transmitted at point A . So that we can confirm that there is breakage between these two points, ranging this breakage will be discussed in the topic "Ranging Technique"

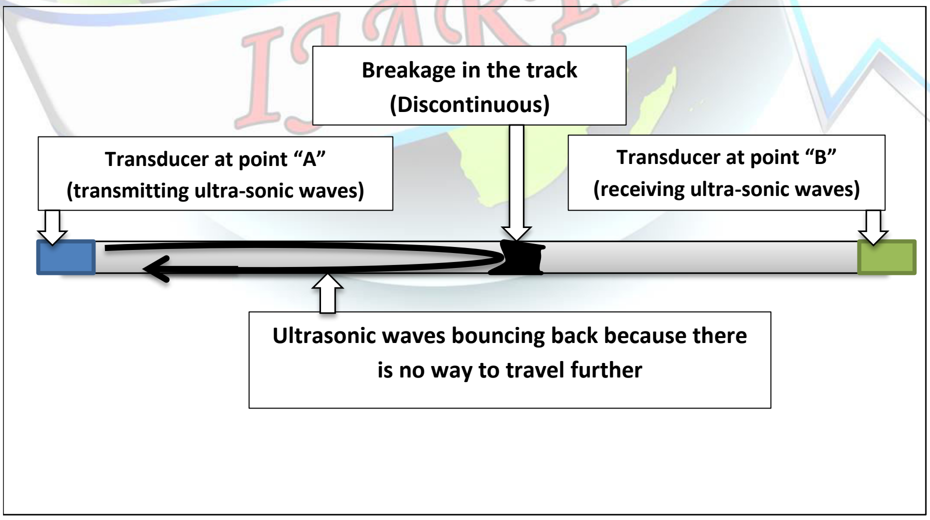

Figure 6.US Waves reflecting at broken railway track.

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When the breakage is developed on the railway track, there is no path for a flow of US waves; hence the waves will not be received by the transducer at point B. The wave is reflected back to the transducer at point A. This data is sent to the centralized server for analyses.

B. Ranging Technique

When there is a crack or breakage developed on the railway track, Centralized server can notice the wave that are reflected back to point A from crack or breakage and it also analyses the time interval of the transmitted and the reflected wave. In between the points A and B, exact location of crack or breakage can be traced.
By using the formula,

$$speed = \frac{2 * distance\ travelled}{time\ interwal}$$

$(2 * distance\ travelled\ is\ because\ the\ wave\ is\ reflected\ back)$
(Generally the speed of US waves in the railway track [iron] is around 5000 m/s)

We can calculate the exact point at which a crack or breakage is developed between the point A and B, all these calculations are happened in the centralized server on the basis of the data that is received from the transducer. Then the notification is sent to the concerned authority along with an exact location of crack or breakage. (Details of location are derived from the GPS module in the transducer).

II. Foreign Object detection on the railway track

Due to natural calamities and other reasons there might me chances of foreign bodies blocking the railway track, which hinders the movement of train and cause accidents. Using this method we can find an appropriate solution to detect foreign bodies on the railway track.

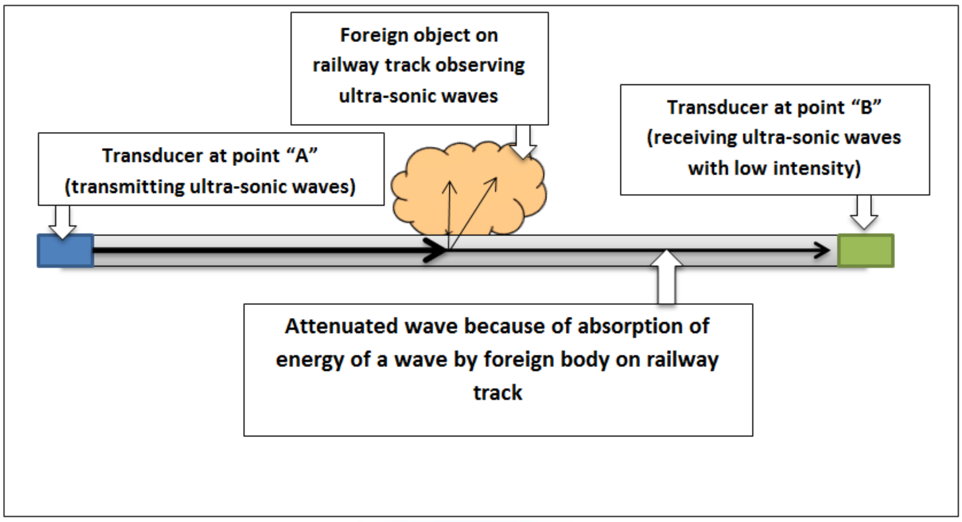

Figure 7. US waves absorption by foreign body on the railway track

When US waves are passed from transducer at the point A, if there is any foreign bodies on the track it absorbs some amount of waves. Then the attenuated wave is detected at the transducer at the point B. Every object has its own absorption capacity, which changes from material to material. Depending upon the loss of energy that is sensed by the transducer, server analyses the quantity, shape and other data related to foreign object. Then information is sent to the concerned authority, stating that some foreign object is detected between those two sensor points, this can be further examined using drones or real time satellite imaging.

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VI. SCOPE FOR DEVELOPMENT (FUTURE WORK)

There is scope for development in the ranging of foreign object on the railway track; in our work we cannot predict the exact location of the foreign object, but we can predict the approximate location between the transducer. In our work we will take help of drones to get the real time image of the suspected area. If we get an access to the real time satellite imaging we can exactly locate the foreign body within the suspected area by using our method in very small interval of time

VII. CONCLUSION

The proposed Railway Track Crack and Obstacle Detector system automatically detects the faulty rail track without any human intervention. There are many advantages in the proposed system when compared with the traditional detection techniques. The advantages include less cost, low power consumption and less analysis time (it can analyze and inspect the track at the speed of 5000m/s). By this proposed system the exact location of the faulty rail track can easily be located which will mended immediately so that many lives can be saved

REFERENCES

[1] Shankarkumar J, Rakshith Kaushik T R "Automated Railway Track Tracing System Using Ultrasonics " International Journal of Industrial Electronics and Electrical Engineering, ISSN: 2347-6982 Volume-2, Issue-11, Nov.-2014

[2] Diksha Nagdevte1, Mohammad Zakir J, " Detection of crack In Rail Road Using Ultrasonic and PIR" International Research Journal of Engineering and Technology (IRJET) .Volume: 04 Issue: 01 | Jan -2017

[3] Mr.Prashanth.addagatla , Mr.G.Koteshwar RaoK. Elissa, "A Modern Method for Detecting Cracks In Railway Tracks By The Efficient Utilization Of LDR And LED System." International Journal of Engineering Science Invention

[4] Amrutha M P, Dr. Vince Paul, Krishnadas ," Early Detection of Obstacles in the Railway Track and Crack Identification System", International Journal of Innovative Research in Computer and Communication Engineering, Vol. 5, Issue 4, April 2017

[5] Kavin S, Jeeva D, Ragesh Kumar A, Kavithapriya C J "Monitoring in Railway Track Crack and Obstacles Using Smart Sensors". International Journal of Advanced Research Trends in Engineering and Technology (IJARTET) Vol. 3, Special Issue 9, March 2016

[6] Ryo Toha,Shun Kawaharaa, Tsutomu Watanabeb, Seiichi Motookaa "Effect of Rayleigh Wave on Ultrasonic Underground Imaging" 2015 International Congress on Ultrasonics, 2015 ICU Metz.

