RailAcoustic®

RAILACOUSTIC ©

high precision smart acoustic

BROKEN AND DAMAGED RAIL DETECTION SYSTEM

Designed and Developed by

enekom
yaşam için teknolojiler

ENEKOM is an Energy Ecology Informatics and Engineering Company

RailAcoustic®

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RAILACOUSTIC 'RKAS-V2'' model

WORKING PRINCIPLES AND CHARACTERISTICS

TABLE 2 Derailment Frequency and Severity by Accident Cause on Class I Main Lines, Sorted by Frequency
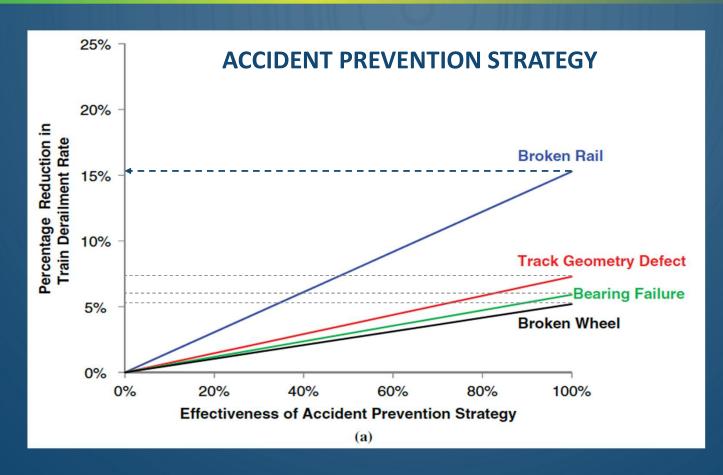
Cause Group	Description	Derailments		Cars Derailed		Average Number of Cars Derailed per Derailment
		Number	Percentage	Number	Percentage	
08T	Broken rails or welds	665	15.3	8,512	22.7	12.8
04T	Track geometry (excluding wide gauge)	317	7.3	2,057	5.5	6.5
10E	Bearing failure (car)	257	5.9	1,739	4.6	6.8
12E	Broken wheels (car)	226	5.2	1,457	3.9	6.4
09H	Train handling (excluding brakes)	201	4.6	1,553	4.1	7.7
03T	Wide gauge	169	3.9	1,729	4.6	10.2
01M	Obstructions	153	3.5	1,822	4.9	11.9
05T	Buckled track	149	3.4	1,891	5.0	12.7
04M	Track–train interaction	149	3.4	1,110	3.0	7.4
11E	Other axle or journal defects (car)	144	3.3	1,157	3.1	8.0
04H	Employee physical condition	3	0.1	41	0.1	13.7
06H	Radio communications error	3	0.1	13	0.0	4.3
14E	TOFC–COFC defects	2	0.0	2	0.0	1.0
03E	Handbrake defects (car)	1	0.0	2	0.0	2.0
	Total	4,352	100	37,456	100	8.6

NOTE: UDE = undesired emergency (brake application); TOFC = trailer on flat car; COFC = container on flat car.

NEXTRANS Project (2012) - Analysis of Causes of Major Train Derailment and Their Effect on Accident Rates (2001-2010), University of Illinois
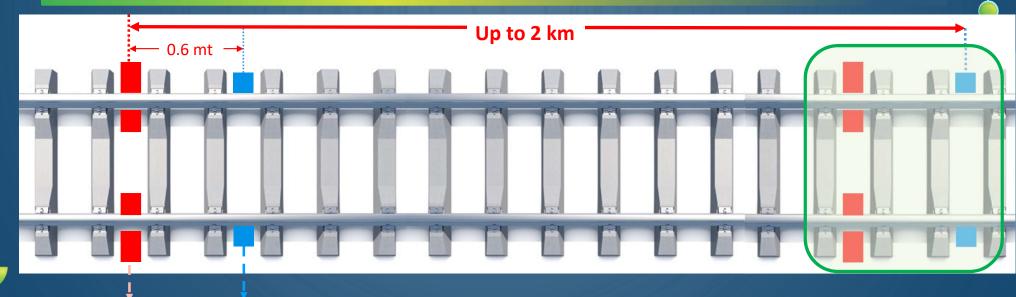
ACCIDENT PREVENTION STRATEGY

BASIC WORKING PRINCIPLES OF RAILACOUSTIC SYSTEM

Up to 2 km

0.6 mt

A NODE

SIGNAL GENERATOR

SIGNAL DETECTOR

BROKEN OR DAMAGED RAIL SEGMENT IS DETECTED ANYWHERE IN BETWEEN

WORKING PRINCIPLES RAILACOUSTIC SYSTEM

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Up to 2 km   Up to2 km

A NODE

both modules are mounted on to the rail body in a moduler way
no need for any welding or putting holes
on the rails for the assembly of modules

51 sensing points for a 100 Km long railway line each
identified with a **unique IP address**

CCSM-100 (Control Center Software Module)

13 cm
30 cm

RAG-100

signal **GENERATOR/INJECTOR**
Smart Acoustic Signal

RASP-100

Track-Side Sensing Station **RailAcoustic**
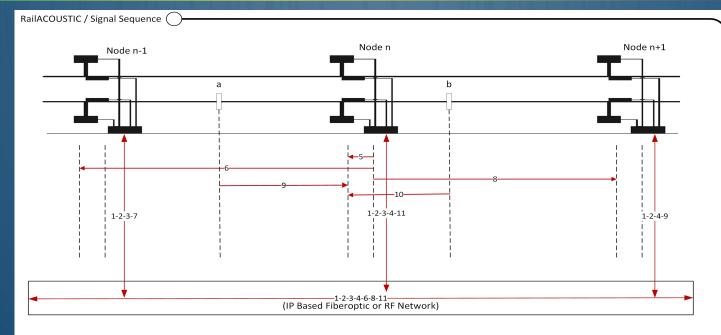**System Processor**

5 cm
10 cm

RAR-100

signal **RECEIVER** (Detector)
sensing the Acoustic Signal from
Rails

all data are transferred to **THE CONTROL CENTER** via fiber optic or RF communication

RailACOUSTIC / Signal Sequence

Node n-1   Node n   Node n+1

a   b

5
6
9
8
10

1-2-3-7   1-2-3-4-11   1-2-4-9

1-2-3-4-6-8-11
(IP Based Fiberoptic or RF Network)

Notes:

1- 'Start Test' command comes to nodes n,n-1 and n+1, from central command computer via the IP network.
2- 'Get Ready' command is generated from node n and directed to both n-1 and n+1 nodes.
3-4- 'I am Ready' messages are directed by both n-1 and n+1 nodes to node n.
5- The signal is injected to the rail at node n. The signal is received by the sensor at node n.
6- The signal is received by the sensor at node n-1.
7- The signal is processed by the sensor at node n-1 and the result is sent to central computer.

8- The signal is received by the sensor at node n+1.
9- The reflected signal from the fault point at 'a' is received by the sensor at node n.
10- The reflected signal from the fault point at 'a' is received by the sensor at node n+1
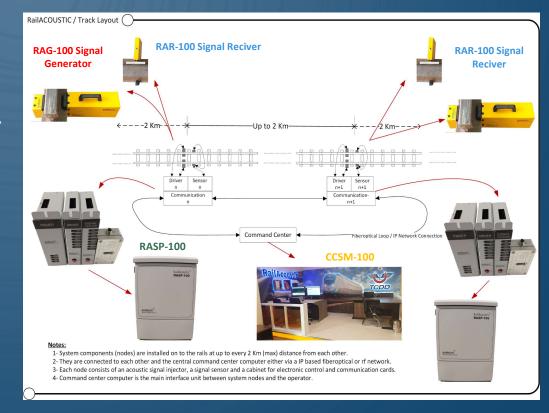11- The signal is processed by the sensor at node n and the result is sent to central computer.

WORKING PRINCIPLES RAILACOUSTIC SYSTEM

1. **RAG-100 (GENERATOR)**: a wide band / white noise acoustic signal generator/injector

2. **RAR-100 (RECEIVER)**: an acoustic signal receiver

3. **RASP-100 (SYSTEM PROCESS)**: a cabinet with communication and signal processing cards and a power supply, distributed along trackside. All equipment is connected to an **IP based fiberoptic or optionally encrypted RF network for communicating** to each other.

4. **CCSM-100 (CENTRAL CENTER SOFTWARE MODULE)**: a computer which is connected to the system's communication network, running an operator consol software as an operator's interface module.

DESIGNED FOR EXTREME CLIMATIC CONDITIONS: all system components are designed to operate in extreme climatic conditions such as **-40^0 - $+80^0$ celsius** operational temperature and 95% relative humidity.

THE SYSTEM'S POWER: module is suitable for mains voltages between 90 – 254VAC @ 50 – 60 Hz.

RASP-100

RailACOUSTIC / Track Layout

RAG-100 Signal Generator

RAR-100 Signal Reciver

RAR-100 Signal Reciver

2 Km — Up to 2 Km — 2 Km

Driver n / Sensor n / Communication n

Driver n+1 / Sensor n+1 / Communication-n+1

Command Center

Fiberoptical Loop / IP Network Connection

RASP-100

CCSM-100

Notes:
1- System components (nodes) are installed on to the rails at up to every 2 Km (max) distance from each other.
2- They are connected to each other and the central command center computer either via a IP based fiberoptical or rf network.
3- Each node consists of an acoustic signal injector, a signal sensor and a cabinet for electronic control and communication cards.
4- Command center computer is the main interface unit between system nodes and the operator.

WORKING PHYLOSOPHY OF RAILACOUSTIC "RKA-V1 MODEL"

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HIGH PRECISION - SAFE - SMART
DYNAMIC AND RELIABLE SENSING SYSTEM
working with 2 methods combined

BY SENSING THE **CHANGE**
IN AMPLITUDE

1 **+** **2**

BY SENSING THE **REFLECTED**
SIGNAL FROM BROKEN RAIL

UNIQUE AND MOST RELIABLE DETECTOR

- An Acoustic Signal with a special characteristic
- Exempt from all sorts of extereme climatic conditions
- Self learning and adapting algorithm to external conditions

RAILACOUSTIC APPLICATION PROJECT

THE SYSTEM HAS BEEN APPLIED to ANKARA-KONYA High Speed Line (HSL) in 2018

Railacoustic Installed Track

RASP100 Track Signal Processor and Communication Cabinet

CONTRACT DATE:
06 April 2018

CONTRACT SCOPE:
Installation of RailAcoustic – Broken Rail Detection and Measuring System At 90 Km Double Track Section of Ankara-Konya High Speed Train Line + 4 Km Conventional Single Track Line (In Ankara)

CONTRACTUAL COMPLETION DATE:
02 December 2018

SYSTEM COMPONENTS OF RAILACOUSTIC AS APPLIED TO TRACK

THE SYSTEM HAS BEEN APPLIED to ANKARA-KONYA High Speed Line (HSL) and is in use NOW

RAG100 and RAR100 Modules Installed on to the Rails

TECHNICAL SPEC HIGHLIGHTS:

- High Speed Train Line and Conventional Line Use,
- Broken Rail Detection Without Need of Train Moving,
- Maximum 2 Km Site Installation Intervals,
- Realtime Monitoring of Tracks From a Remote Control Center,
- Data Storage and Customized Reporting With History Records,
- System Hardware, Software, Installations, Trainings and Warranty Period Service.

RAILACOUSTIC SIGNAL PROCESSING UNIT (RASP100):

This electrical signal processing, control and communication cabin is located along the track at up to each 2 Kms distance along the track for housing the electronic boards, power supply and the fiberoptical network communication controller.

THE SYSTEM HAS BEEN APPLIED to a 90 Km long Double Line and 4 Km Single Line segment on ANKARA-KONYA High Speed Line (HSL) and it is in use NOW – RKS100 Acoustic Coupler

RAIL ACOUSTIC GENERATOR (RAG100):

- Acoustic signals are injected into the rails thru this unit. The unit is attached onto the rails without any welds or holes but by only using a specially designed clamp mechanism.

RAIL ACOUSTIC RECEIVER (RAR100):

- This signal sensing module is attached to the rail for sensing the acoustic signals generated by the RAG100 unit. It first detects and processes the detected acoustic signal and communicates with the track-side electronic board for additional signal processing and communication.

THE SYSTEM HAS BEEN APPLIED to a 90 Km long Double Line and 4 Km Single Line segment on ANKARA-KONYA High Speed Line (HSL) and it is in use NOW– Open Line View

THE SYSTEM HAS BEEN APPLIED to a 90 Km long Double Line and 4 Km Single Line segment on ANKARA-KONYA High Speed Line (HSL) and it is in use NOW– In the Tunnel

CONTROL ROOM VIEW OF RAILACOUSTIC SYSTEM

THE SYSTEM HAS BEEN APPLIED to a 90 Km long Double Line and 4 Km Single Line segment on ANKARA-KONYA High Speed Line and it is in use NOW – Eryaman Alarm Control Center - Operator Terminal View

CONTROL CENTER HW & SW (CCSM-100):

ALARM-CONTROL CENTER SOFTWARE MODULE (CCSM-100):
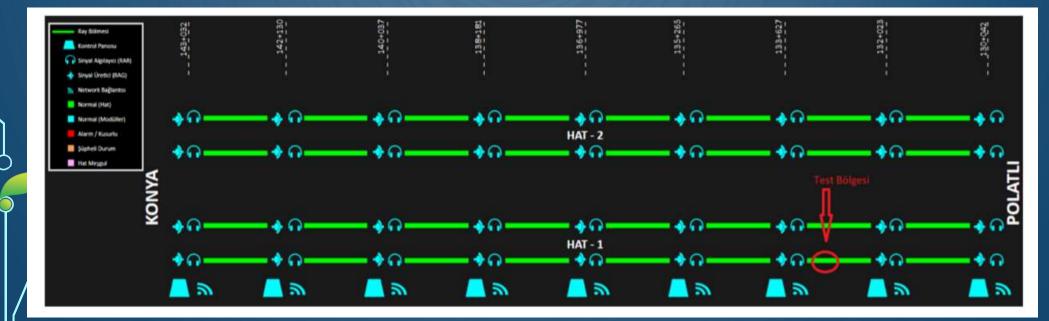
- A central command and monitoring program for operating the system under the supervision of a system operator. The system consists of a computer with a multi screen display, a program running in this computer, a data base operation for controlling, monitoring and remote accessing to each system module in real time.

- The system modules are connected to the alarm-control center computer via a fiber-optical IP network.

CONTROL ROOM VIEW OF RAILACOUSTIC SYSTEM

THE SYSTEM HAS BEEN APPLIED to a 90 Km long Double Line and 4 Km long Single Line segment on ANKARA-KONYA High Speed Line (HSL).
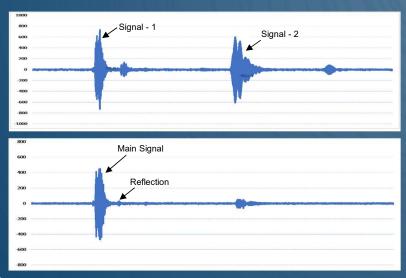
The system is in use NOW after two times random rail cut tests are performed and accepted by TCDD.

RAILACOUSTIC SYSTEM CUT TEST

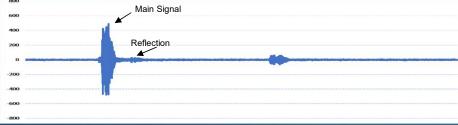**THE SYSTEM HAS BEEN APPLIED to a 90 Km long Double Line and 4 Km long Single Line segment on ANKARA-KONYA High Speed Line (HSL). The system is in use NOW after two times random rail cut tests are performed and accepted by TCDD.**

TEST NO : 1 – RAIL HEAD PARTIAL CUT TEST
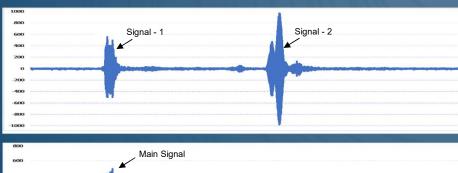
5 cm deep partial cut. A significant change in the received waveform is observed. Reflection signal has identified the rail fracture and its location. Command center computer has registered the fault as 'Level-1 Insignificant Damage' to the rail.

RAILACOUSTIC SYSTEM CUT TEST

THE SYSTEM HAS BEEN APPLIED to a 90 Km long Double Line and 4 Km long Single Line segment on ANKARA-KONYA High Speed Line (HSL).
The system is in use NOW after two times random rail cut tests are performed and accepted by TCDD.

TEST NO : 2 – RAIL HEAD FULL CUT TEST

The head of the rail was completely cut and a fracture test was performed. A typical and significant change in the received waveform is observed. Reflected signal has identified the fault and the location. Command center computer has registered the fault as 'Level-2 Significant Damage' to the rail.
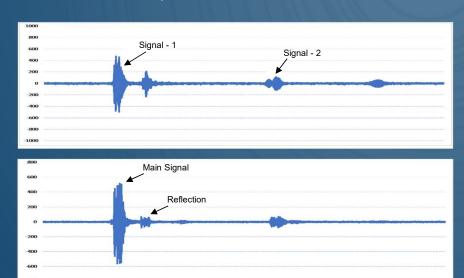
RAILACOUSTIC SYSTEM CUT TEST

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THE SYSTEM HAS BEEN APPLIED to a 90 Km long Double Line and 4 Km long Single Line segment on ANKARA-KONYA High Speed Line (HSL).
The system is in use NOW after two times random rail cut tests are performed and accepted by TCDD.
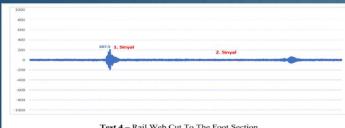

TEST NO : 3 – RAIL WEB HALF WAY THRU CUT

The web of the rail was cut in half and a new fracture test was performed. The result of the test showed that the signal shape and signal levels changed significantly. At the end of the test, the system automatically generated Level-3 Significant Damage / Brown Alarm Signal in the form of a critical rail fracture alarm. The damage location has been identified precisely.
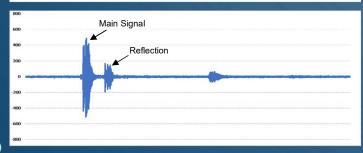
RAILACOUSTIC SYSTEM CUT TEST
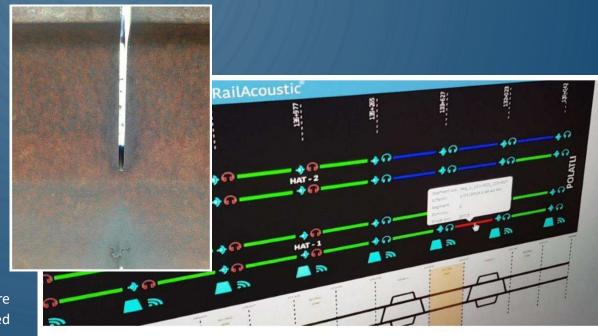
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THE SYSTEM HAS BEEN APPLIED to a 90 Km long Double Line and 4 Km long Single Line segment on ANKARA-KONYA High Speed Line (HSL). The system is in use NOW after two times random rail cut tests are performed and accepted by TCDD.

Test 4 – Rail Web Cut To The Foot Section

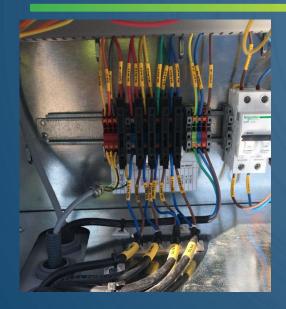Broken Rail Indication On The Monitoring Screen of Command Center Computer

The web of the rail was cut to the foot and the fracture test was performed. The signal level, shape and reflected component has totally changed. At the end, the system generated a Level-4 Significant Damage / Red Alarm Signal. The location of the damaged rail has been identified precisely.

TEST NO : 4 – CUT TO THE RAIL FOOT TEST

MANUFACTURING PHASE OF RAILACOUSTIC SYSTEM

INSTALLATION OF THE RAILACOUSTIC SYSTEM

RAILACOUSTIC OTHER USES

- Detection of :
  - Landslides,
  - Floods,
  - Snow Accumulation,
  - Train Movement Monitoring,
  - Train Speed Monitoring,
  - Train Wheel-Flats.

Energy Ecology Informatics Engineering

technologies for a sustainable life

- INVENTOR AND DEVELOPER OF THE TECHNOLOGY

- 8 PATENTS ON THIS AND OTHER R&D PROJECTS REGISTERED LOCALLY AND INTERNATIONALLY

- LOCATED IN METU (Middle East Technical University) TECHNOPOLIS in Ankara

- GOVERNMENT – UNIVERSITY – INDUSTRY COOPERATION AND CONNECTIONS

- FOCUSED ON OPTIC AND SPECTROMETRIC RAILWAY DETECTION TECHNOLOGIES

RailAcoustic®

THANK YOU !

INTERNATIONAL

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