機電工程署
EMSD

IRSC

INTERNATIONAL RAIL SAFETY

SC 2023

IR

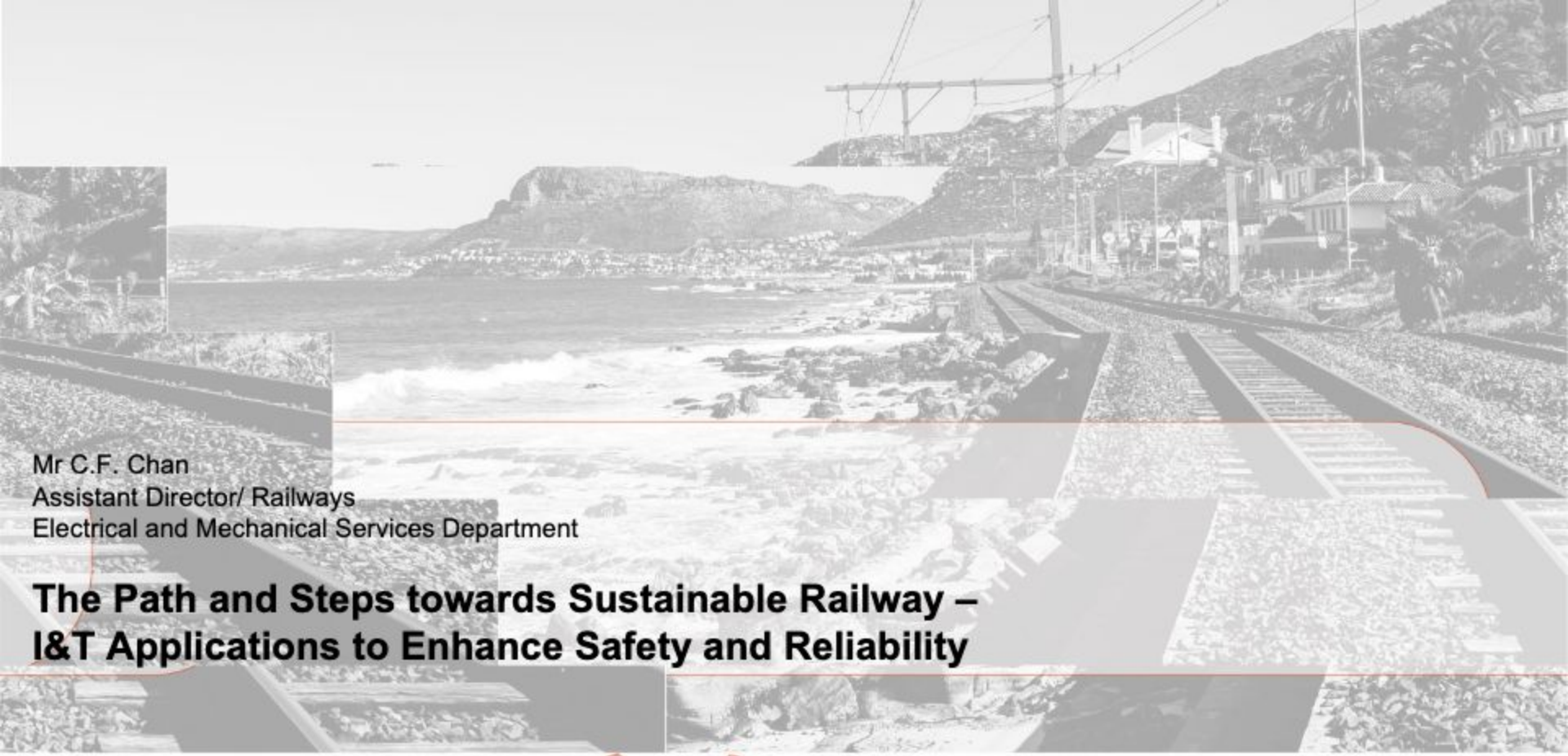
INTERNATIONAL RAILWAY
SAFETY COUNCIL

"Reshaping Railways in an Uncertain World"

CAPE TOWN. OCTOBER 1 - 6, 2023

HOSTED BY

RAILWAY SAFETY REGULATOR
RAIL SAFETY ON THE RIGHT TRACK



Mr C.F. Chan
Assistant Director/ Railways
Electrical and Mechanical Services Department

The Path and Steps towards Sustainable Railway – I&T Applications to Enhance Safety and Reliability

Railway Safety Regulation in Hong Kong

Railway Safety Regulation in Hong Kong



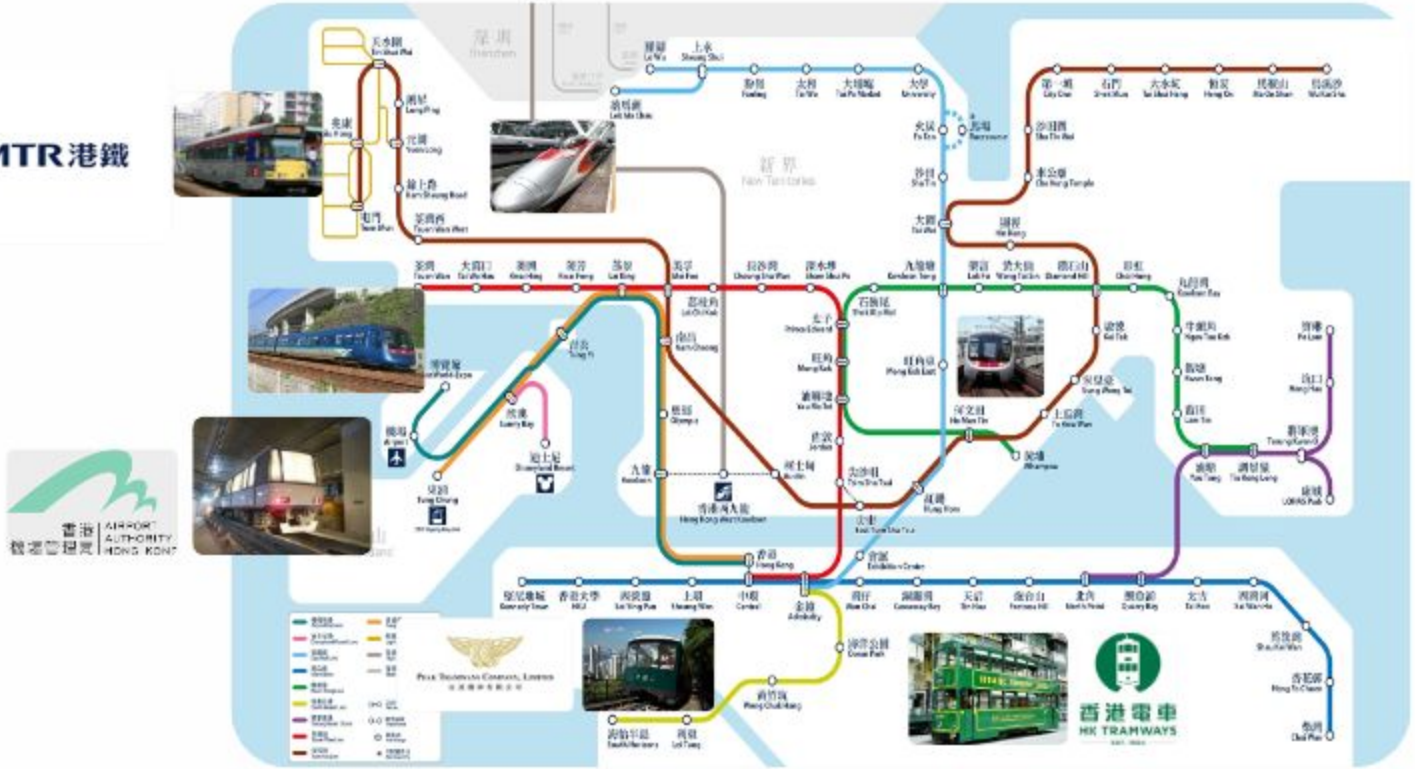
EMSD is the railway safety authority of Hong Kong. Major duties include:

- Assessment and approval of new railways and major modifications
- Safety inspections and audits
- Investigation of safety-related railway accidents
- Approval and recommendation of improvement measures
- Safety promotion and public education

Regulator-Regulatee Partnership Approach

Communication Workshop
Regular I&T Forum

Hong Kong Railway Lines



Role of Innovation Facilitator

EMSD is the "**Innovation Facilitator"** on I&T applications. We support and facilitate the application of innovative technologies by railway operator to improve services and support smart city development

Facilitating and Promoting I&T Applications

E&M Inno-Portal

https://inno.emsd.gov.hk/en/home/

Railway Safety Regulator and railway operator

1 Post the "I&T Wishes" for resolving specific railway safety problems

4 Accept appropriate I&T proposal and initiate pilot project

E&M InnoPortal®

2 List the wish on "I&T Wish List"

I&T Solution Provider

3 Propose their innovative solutions to the "wish"

MTR港鐵 香港電車 HK TRAMWAYS PEAK TRAMWAYS COMPANY, LIMITED

5 Coordinate with railway operators to implement pilot I&T projects in railway

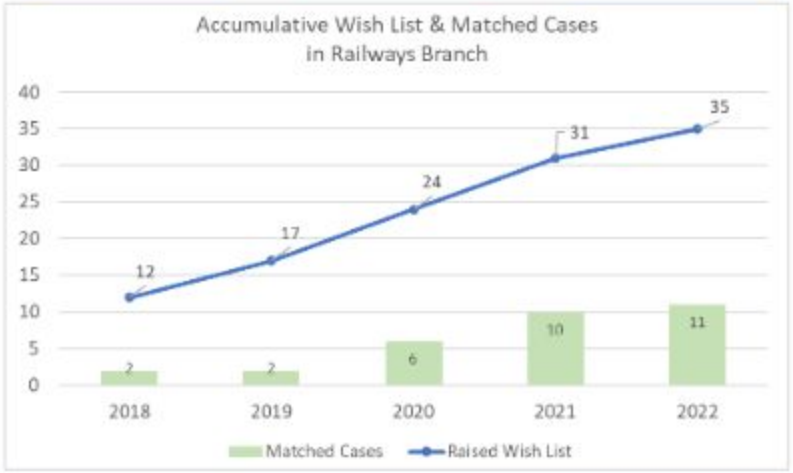
E&M Inno-Portal

https://inno.emsd.gov.hk/en/home/

Initiatives from Various Sectors
(as at Aug 2023)

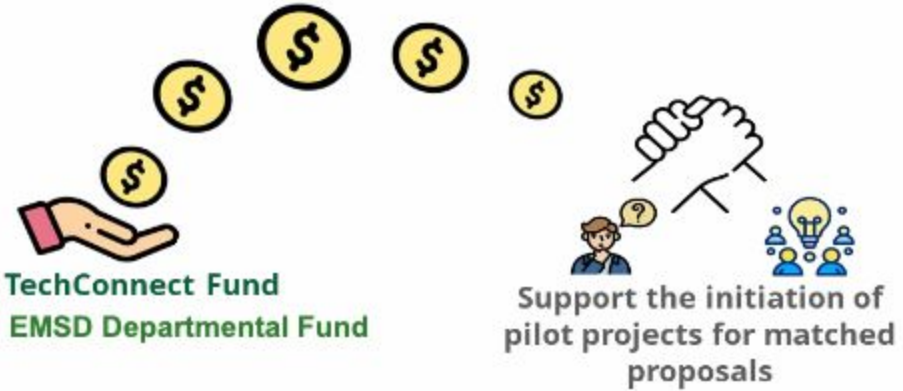
I&T Wishes	I&T Solutions	I&T Trials
440+	1,110+	180+

Railways Branch



Funding

- Hong Kong SAR Government offers various funding for promoting I&T applications
- The Innovation and Technology Bureau (ITB) rolled out a funding scheme, **TechConnect (block vote)**, and **EMSD Departmental Funding** to enhance the railway safety in Hong Kong
- Funding of **14 pilot projects** related to railway safety have been approved



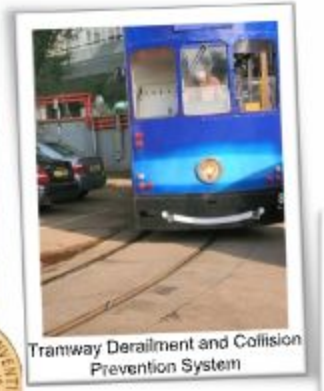
Foster I&T Development

Participate in International Competitions

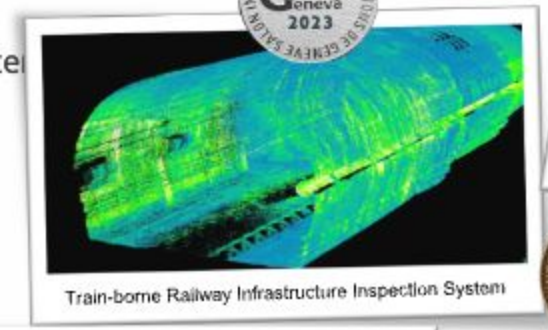
- EMSD won 5 railway safety related awards at 48th International Exhibition of Inventions of Geneva in Apr 2023

  Special Prize "Thailand Award for the Best International Invention & Innovation" & "Gold" medal:

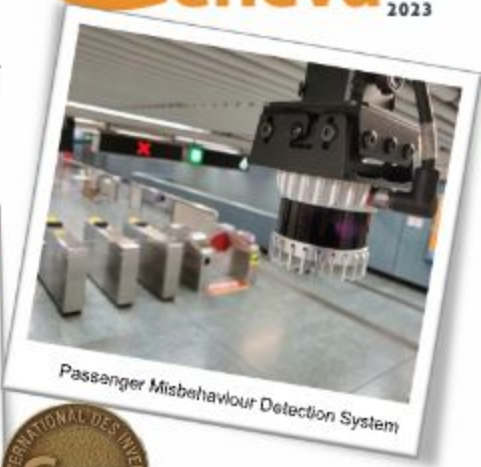
  - Tramway Derailment and Collision Prevention Syste



Tramway Derailment and Collision Prevention System



Train-borne Railway Infrastructure Inspection System



Passenger Misbehaviour Detection System

Rail Track Object Detection System

Foster I&T Development

Organise I&T Seminars, Technical Visits, I&T Competitions and Establish E&M AI Lab

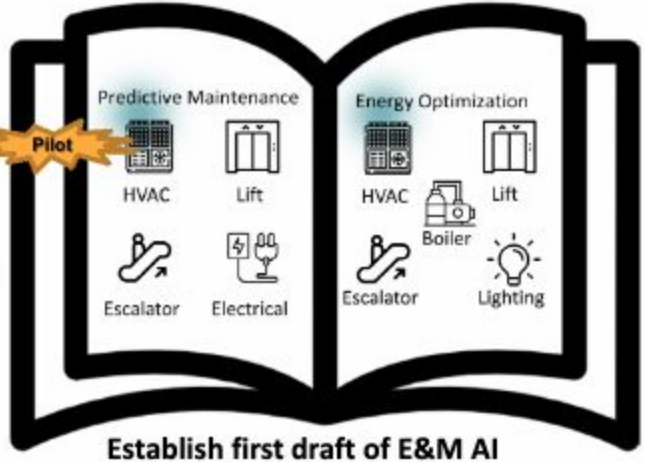
Foster I&T Development

Establish first draft of AI Data Standardization Guideline

National Regulation & EMSD Guideline

National and International Standard

Pilot



Establish first draft of E&M AI Data Standardization Guideline

Hong Kong

Greater Bay Area

Data sharing among different E&M AI systems on multi-cloud platform

Apply the Guideline on pilot venues

Data sharing with GBA and international organizations

Examples of I&T Applications

Examples of I&T Applications

1	Escalator Accident Detection and Safety Message Dissemination System
2	Semantic AI for Predictive Maintenance of Railway Track System
3	Internet of Things (IoT) Vibration Sensor Installed at Advertising Panels
4	Real-time intrusion detection at track sections
5	AI-based Object Detection System at Jordan Station
6	Small Object Detection for Escalator
7	Smart Driver Assistant for Automated People Mover
8	Incident Trend AI Data Analytics to Enhance Railway Safety
9	AI Data Analytics on Concession Applications for Delayed Maintenance Activities
10	Tram Speed Alert System
11	Tramway Derailment and Collision Prevention System
12	Adoption of 3D Point Cloud Technology for AI Analytics of Railway Infrastructure Condition
13	Haulage Rope AI Condition Monitoring System for Peak Tramway System
14	Railway Passengers Running Detection System

Tramway Derailment and Collision Prevention System

機電工程署 EMSD

香港電車 HK TRAMWAYS EST. 1904

Akira Kan

Tramway Derailment and Collision Prevention System

- HK Tramways running across Hong Kong Island

Hong Kong Island

- Road conditions vary from time to time

Tramway Derailment and Collision Prevention System

Challenges & Problems

- Small foreign objects trapped on the tram track might cause derailment or collision
- It is difficult to spot the objects with naked eyes under night time/ bad weather conditions / bright sunlight by Tram drivers
- There are privacy concerns for people facial detection in Hong Kong

Tramway Derailment and Collision Prevention System

Inventions

Change Detection and Multi-level Objects Detection Deep Learning

- Georeferenced point clouds that are generated from the three coupled and synchronized LiDARs
- Two-stage framework for 3D point cloud object detection

Base Map

Real-time Condition

Real-time long range & fast response small object detection

- Real-time detection of object at 60m away
- Triggering instant alert to driver in 0.1s

Tramway Derailment and Collision Prevention System

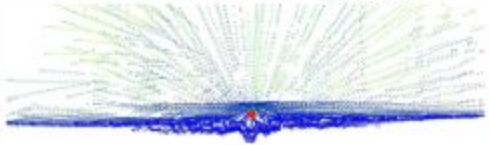
- **GNSS antenna**
  - Tram localization

- **Top LiDAR (128-line)**
  - Tram positioning if no GNSS signal is received
  - Overview of foreign objects resting on tram tracks are cars/ pedestrians/ target objects resting on track

- **Bottom LiDARs (Solid-state)**
  - Detection of foreign objects on tramway track

- 50% increment of nos. of points in new condition VS base map

Base Map | Real-time Condition



Trigger Alert

Tramway Derailment and Collision Prevention System

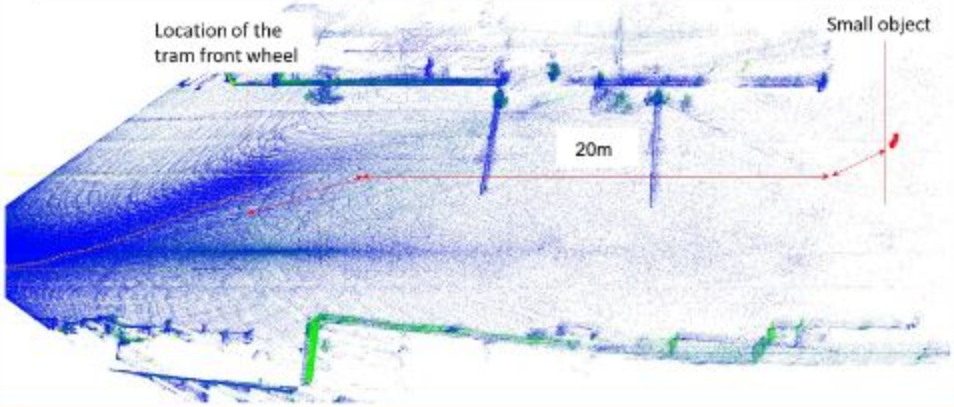
Results of Depot Test

- Testing Period : Mar - Sep 2022

Bolt & nut

- At crossing track

Small object	Min. Stopping Distance (m)	Alarm Triggering Distance (m)	Actual Stopping Distance (m)
Bolt & nut  Dimension: 146mm x 26mm	12.0	27.5	20
Metal Object  Dimension: 90mm x 50mm		29.0	22.5

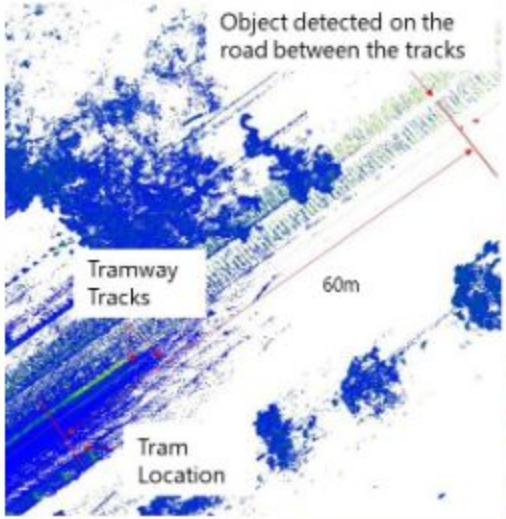


Tramway Derailment and Collision Prevention System

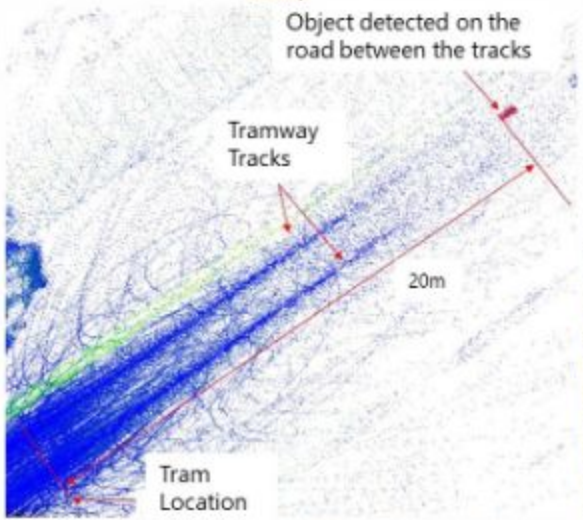
Results of Trial Operation

- Trial operation period: 3 Nov – 4 Dec 2022
- **No false alarm** recorded
- No foreign objects was found on track
- 2 unknown objects found on road between tracks at 60m away from the object

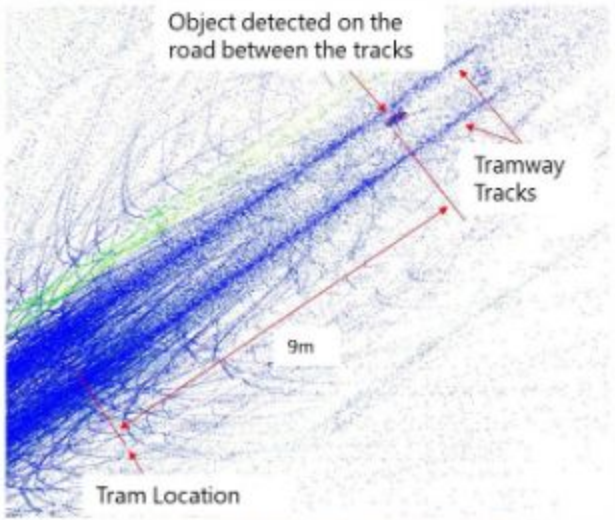
Unknown Object Case (Size about 10cm x 40cm)



(60m Away from the Object Detected)



(20m Away from the Object Detected)



(9m Away from the Object Detected)

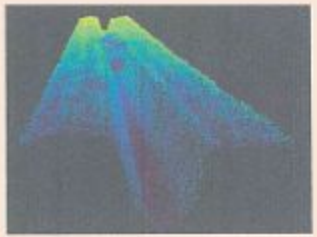
Tramway Derailment and Collision Prevention System

Achievement

- System Accuracy **99%**

- World first double-deck tram borne Real-time Detection

- Monitoring Tram Speed for Operational Safety



- Real-time Tram Track Condition Monitoring


New Challenges

Hong Kong Torrential Rainfall

Climate Change Challenge

Conclusions

Conclusions

- With expanding railway networks and patronage, ageing railway assets and climate change, maintaining a safe operation of railways in Hong Kong become more challenging
- EMSD is committed to expedite the I&T transformation to sustain improvement in railway safety and regulatory enforcement in railway safety
- Through adopting a regulator-operator partnership approach, EMSD leads by example to carry out proof of concept projects to demonstrate a series of I&T solutions to the railway operators
- Looking ahead, EMSD will continue to work towards a smart regulator by enhancing effectiveness and efficiency of work process by digitization and automation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