# Detection of track damage in railway - Train based field test of prototype

Matti Rantatalo, Praneeth Chandran, Johan Odelius, Florian Thiery, Håkan Lind, Olavi Kumpulainen, Anders Thornemo, Ulf Ranggård

# Project purpose

- Reduce manual inspections and humans on the railway track

- Increase safety

- Focusing on railway fatener systems and missing clamps



Pandrol Fast Clip fastening

E- Clip Fastening

Heyback Fastening

Rail Spike



Automated Maintenance

z**ERO**

entry on track
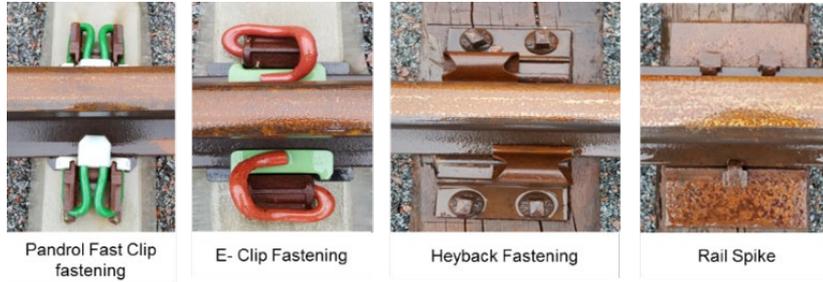
14.000 km of railway lines
93 million clamps

# Background



www.vision-systems.com

## Railway Fastener Inspection by Real-Time Machine Vision

Çağlar Aytekin, Yousef Rezaeitabar, Sedat Dogru, and İlkay Ulusoy



(a)          (b)

Wheel

Light Source

High Speed Camera

PC

Rotary Encoder

Rail Track

(c)
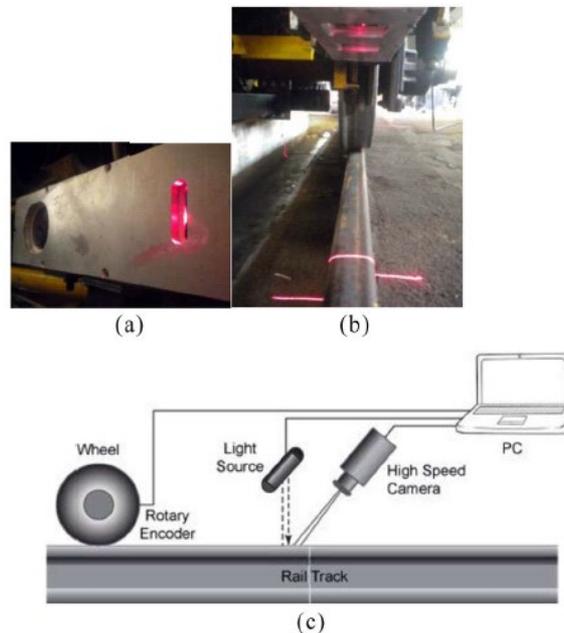
Fig. 1.   (a) Camera and laser source box. (b) Camera and laser source mounted under the track. (c) Schematic of the system.

# Background

- Problem with visuall inspection





https://www.youtube.com/watch?v=CY3AcSYRyDo

# Background
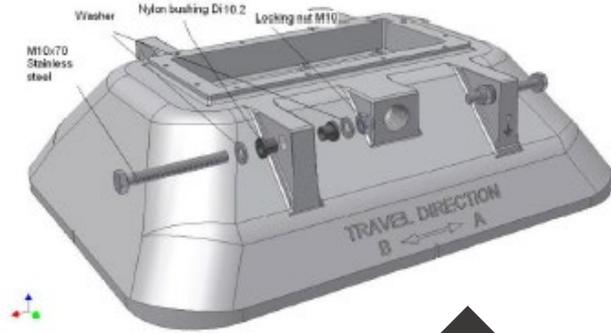


Transmitted magnetic field

Return field
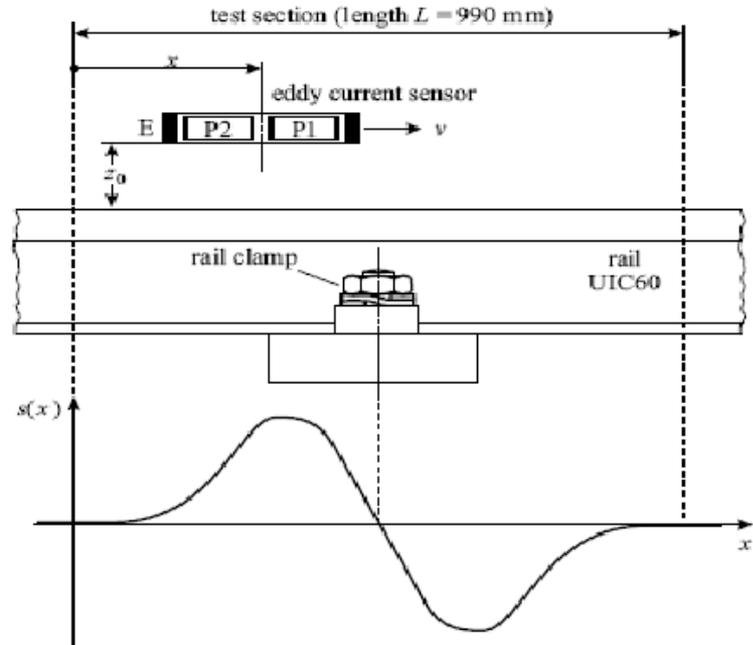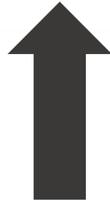
# The three most important results

1. Successful field tests using a in service locomotive

2. Successful identification of missing clamps using ML

3. Detection of additional anomalies (Welds, insulation joints etc)

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# 1 Field test



Travel direction

Ground truth

Lindometer  1  2  3  ............................  3531 3532  ............................  3717 3718

3532 3533 ·····3543 · 3545 · 3555 ·········· 3568 ········· 3588 ·········· 3606 · 3626 ···· 3628 ·········3632 3633 3634 ···· 3638 ·········3618 ········· 3669 ········· 3698 ········· 3718

■ Weld joint
▲ 1 missing clamp
▬ Insulation joint
♦ 2 missing clamp
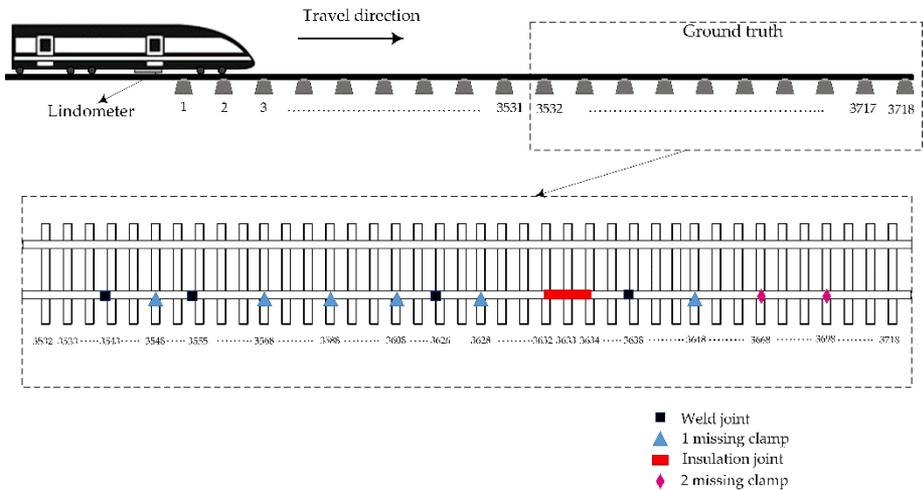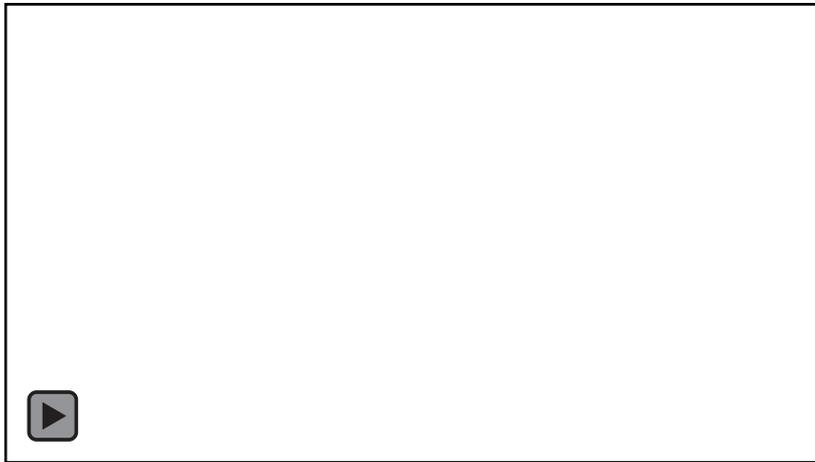
# 2 Unsupervised machine learning
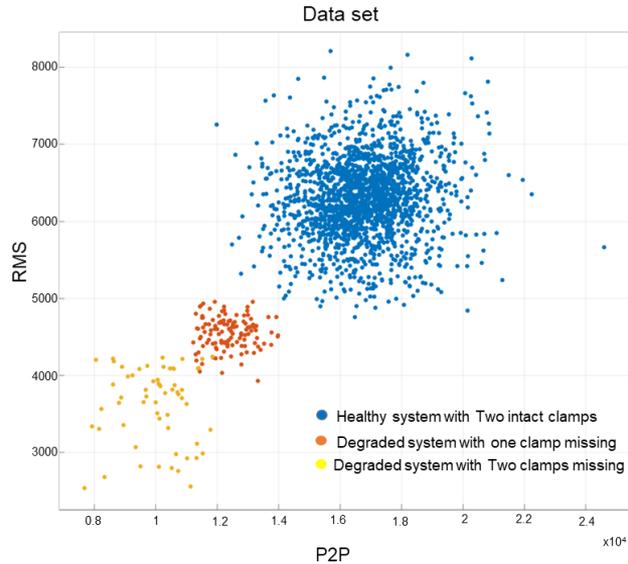


Supervised
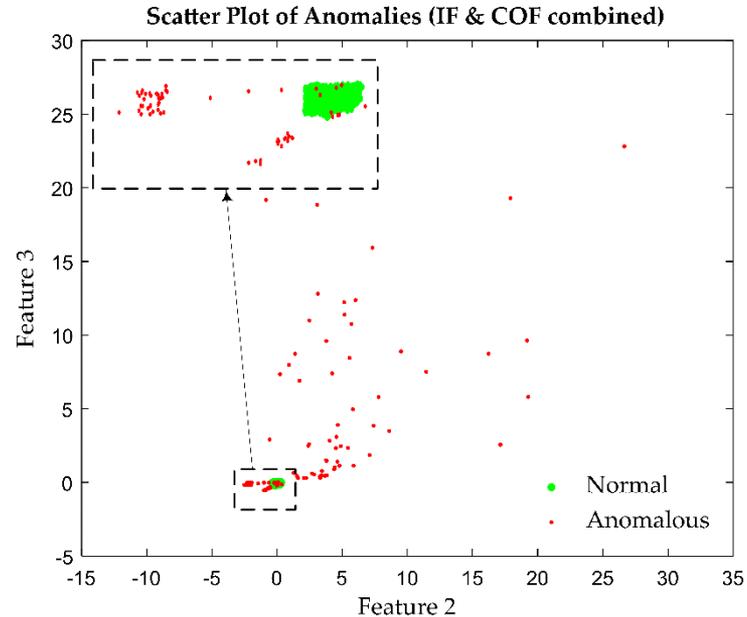


Unsupervised, Anomaly detection

# 2 Unsupervised machine learning
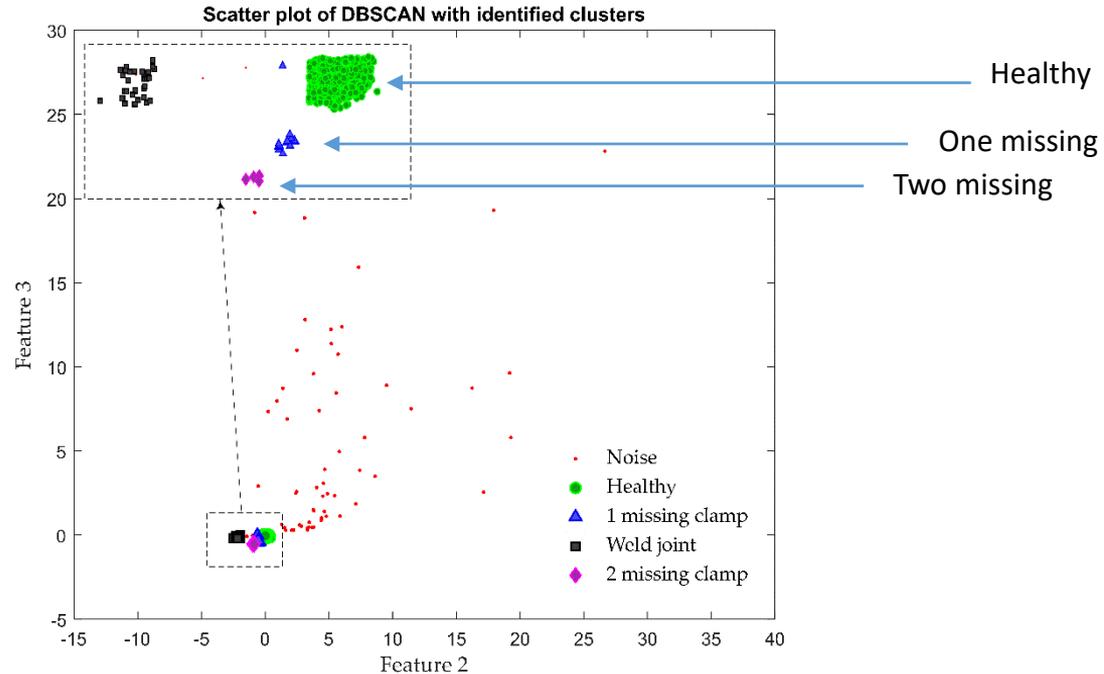


Unsupervised Machine Learning

# 3 Additional anomalies



Scatter plot of DBSCAN with identified clusters

Welds

Noise
Healthy
1 missing clamp
Weld joint
2 missing clamp
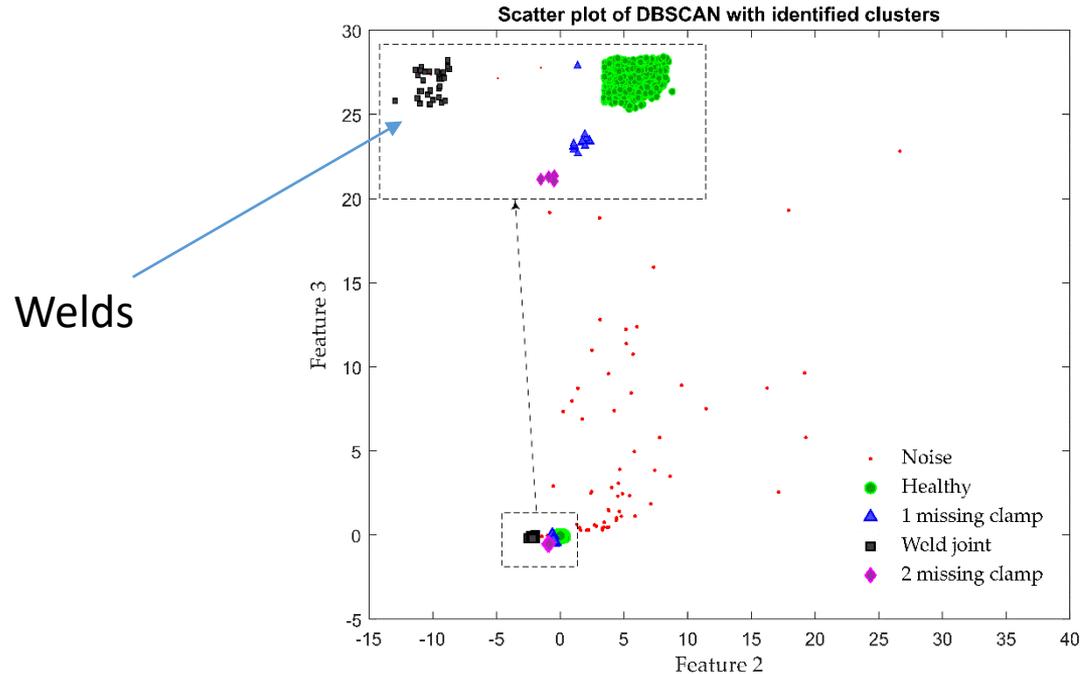
Unsupervised Machine Learning

# Important Learning outcomes

- It is possible to detect fasteners from an in service train at 70 km/h (Theoreticaly 300 km/h)

- Other aspects can also be detected

- ML is a vital part of the solution

- Field tests are difficult to plan and manage. Highly dependedn to scocial parameters and resourse avaialbilities.

- Physical measurement campaigns in the field cost money and is time consuming

# Discussion

- What are the key factors for practical Implementation?

    - Engaged individual people in various organisations  (IMs) which owns the problem.

    - Social relationships

    - Patience

- How to spread the result to generate innovation?

    - Marketing the result in EU projects for other IMs

    - Utilise the result for other applications like detection of other defects (Surface defects)

    - Interact with other IMs with different problems related to the project result (Track geometry measurement)