PROGRAMME

• Opening of the conference by François Davenne
• Opening speech by Gianluigi Castelli
• Presentation by Loïc Hamelin and Giuliana Barbarino
• Presentation by Bill Nie
• Presentation by Joachim Bürkle
• UIC Digital Platform by Francis Bédel

UIC Digital Awards 2019 (Presentations of their projects by the selected startups)
• Bulldozair Services Category
• Cylus Safety Category
• National Engineering Laboratory Productivity Category
• Supraways Special Prize
• Digital Awards ceremony
• Conclusion by François Davenne

UIC Director General
Chairman UIC and Chairman FS
SNCF: "Open software: enhancing operations"
CEO FATRI: "What about Quantum Sensing in the new Smart City Transportation paradigm?"
ZERO.ONE.DATA: "A success story for innovative way of working: cooperation of Rail industry, Corporate Startups and Startups”
UIC Chief Digital Officer: "Overview 2019 activities and roadmap 2020"
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6. UIC Digital Platform by Francis Bédel (UIC Chief Digital Officer: "Overview 2019 activities and roadmap 2020")
7. UIC digital Awards 2019 (Presentations of their projects by the selected startups)
OPEN SOFTWARE: ENHANCING OPERATIONS

UIC digital conference– December, 10th 2019 - Giuliana BARBARINO & Loïc HAMELIN
Open Source Railway Designer

Team SNCF Réseau DGEX Solutions
Bertrand Houzel

Naïma Aftab
Giuliana Barbarino
Lucien Devars Dumayne
Benjamin Gaultier
Paul Guénézan
Loïc Hamelin
Guillaume Lecœur
# PROJECT CONTEXT

<table>
<thead>
<tr>
<th>Political context</th>
<th>Technical context</th>
</tr>
</thead>
<tbody>
<tr>
<td>✓ European railway reform</td>
<td>✓ Non comparable results</td>
</tr>
<tr>
<td>✓ Opening up the market to competition</td>
<td>✓ More and more softwares and « black box » solutions</td>
</tr>
<tr>
<td>✓ State demand for greater economic performance</td>
<td>✓ High licencing costs for research laboratories and operation offices</td>
</tr>
</tbody>
</table>
### PROJECT GOALS

<table>
<thead>
<tr>
<th>Provide an <em>Open Source</em> solution for the software and the data</th>
<th>Create a modular solution that will improve over time and allow</th>
</tr>
</thead>
<tbody>
<tr>
<td>✓ Standardize algorithms</td>
<td>✓ High computational load</td>
</tr>
<tr>
<td>✓ Provide auditable results</td>
<td>✓ Connection to other softwares</td>
</tr>
<tr>
<td>✓ Integrate academics contribution into the process to improve the overall performance</td>
<td>✓ Peripheral development of various modules</td>
</tr>
<tr>
<td>✓ Build a community around the project through open access</td>
<td>✓ Implementation of additional algorithm (optimization…).</td>
</tr>
</tbody>
</table>
GENERAL ARCHITECTURE

GIS: Infrastructure data

GTFS: Time table data

RT: Real time data

WEB API

OSRD CORE

OSRD FRONT
Multiple users, multi screens

DATABASE: Infrastructure data, Time table data, Real time data

WEB API: Data access and data exchange

OSRD CORE: Core functionality

GIS: Infrastructure data

GTFS: Time table data

RT: Real time data

WEB API: Data access and data exchange
ROLLINGSTOCK:

- Physical train characteristics: length (l), mass (m)
- Inertia of rotating mass (i)
- Traction force (T) curve for each power supply
- Resistance formula (Ra)

INFRASTRUCTURE:

- Line profile: gradients (d), radius (d=800/R), maximum speeds (v)

Equation model for the train movement:

Forces and accelerations

\[ a_i = \frac{T(v_i) - Ra(v_i) + m \cdot g \cdot d(x_i)}{m \cdot i} \]

Time discretization

\[ t_{i+1} = t_i + \Delta t \]

Positon of the train x

\[ x_{i+1} = x_i + v_i \cdot \Delta t + \frac{1}{2} a_i \cdot \Delta t^2 \]

Runge-Kutta (Euler) Algorithm

\[ v_{i+1} = v_i + a_i \cdot \Delta t \]
✓ Plotting the train position during the time: the running time calculation for each train is performed independently, the conflicts could be graphically displayed

✓ Plotting the train speed at each positions
DYNAMIC APPROACH: SIMULATION

ROLLINGSTOCK   TIME TABLE   INFRASTRUCTURE

Train

SPEED CONTROLLER: Stops and Signaling

Speed profile

Update train behavior

Driver behavior

WITH ATO?

Real data analysis

SNCF RÉSEAU - DGEX SOLUTIONS

0 100 200 300 400 500 600 700 800 900 1000 1100 1200 1300 1400 1500 1600 1700 1800 1900 2000 2100 2200 2300 2400 2500 2600 2700 2800 2900 3000 3100 3200 3300 3400 3500 3600 3700 3800 3900 4000 4100 4200 4300 4400 4500 4600 4700 4800 4900 5000 5100 5200 5300 5400 5500 5600 5700 5800 5900 6000 6100 6200 6300 6400 6500 6600 6700 6800 6900 7000 7100 7200 7300 7400 7500 7600 7700 7800 7900 8000 8100 8200 8300 8400 8500 8600 8700 8800 8900 9000 9100 9200 9300 9400 9500 9600 9700 9800 9900 10000 10100 10200 10300 10400 10500 10600 10700 10800 10900 11000 11100 11200 11300 11400 11500 11600 11700 11800 11900 12000 12100 12200 12300 12400 12500 12600 12700 12800 12900 13000 13100 13200 13300 13400 13500 13600 13700 13800 13900 14000 14100 14200 14300 14400 14500 14600 14700 14800 14900 15000 15100 15200 15300 15400 15500 15600 15700 15800 15900 16000 16100 16200 16300 16400 16500 16600 16700 16800 16900 17000 17100 17200 17300 17400 17500 17600 17700 17800 17900 18000 18100 18200 18300 18400 18500 18600 18700 18800 18900 19000 19100 19200 19300 19400 19500 19600 19700 19800 19900 20000 20100 20200 20300 20400 20500 20600 20700 20800 20900 21000 21100 21200 21300 21400 21500 21600 21700 21800 21900 22000 22100 22200 22300 22400 22500 22600 22700 22800 22900 23000 23100 23200 23300 23400 23500 23600 23700 23800 23900 24000 24100 24200 24300 24400 24500 24600 24700 24800 24900 25000 25100 25200 25300 25400 25500 25600 25700 25800 25900 26000 26100 26200 26300 26400 26500 26600 26700 26800 26900 27000 27100 27200 27300 27400 27500 27600 27700 27800 27900 28000 28100 28200 28300 28400 28500 28600 28700 28800 28900 29000 29100 29200 29300 29400 29500 29600 29700 29800 29900 30000 30100 30200 30300 30400 30500 30600 30700 30800 30900 31000 31100 31200 31300 31400 31500 31600 31700 31800 31900 32000 32100 32200 32300 32400 32500 32600 32700 32800 32900 33000 33100 33200 33300 33400 33500 33600 33700 33800 33900 34000 34100 34200 34300 34400 34500 34600 34700 34800 34900 35000 35100 35200 35300 35400 35500 35600 35700 35800 35900 36000 36100 36200 36300 36400 36500 36600 36700 36800 36900 37000 37100 37200 37300 37400 37500 37600 37700 37800 37900 38000 38100 38200 38300 38400 38500 38600 38700 38800 38900 39000 39100 39200 39300 39400 39500 39600 39700 39800 39900 40000

m/s

m

m/s

Position (m)
INPUT GIS RAILWAY INFRASTRUCTURE

INFRASTRUCTURE OBJECTS:

- Nodes
- Edge
- Station, routes
- Tracks
- Signals, block sections
- Switches, crossings
DETAILED SIGNALING FOR DRIVING SIMULATION

IMPLEMENTED SIGNALISATION:
- Block automatique lumineux (BAL)
- Transmission voie machine 300 (TVM300)
- Transmission voie machine 430 (TVM430)
- ERTMS
Merci
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Quantum technology used on Smart Bearing of high speed railway

FATRI United Testing & Control (Quanzhou) Technologies Co., Ltd.
High speed rail axle bearing needs to be replace every 1 year.
The potential failure is not easy to find, Since the traditional sensor installation position is far away from the bearing failure point, the sensor signal is weak.
On 13 August 2000, a Qantas Short SD360-300 with two pt6a-67r engines was stopped 35 minutes after take-off by a failure of bearing no. 1 on the right engine;


According to the statistics, among the 18 crashes of the American a-7 aircraft caused by engine failure, 5 of them were caused by the damage caused by spindle bearing failure, and the flight accidents caused by bearing failure accounted for about 27% of the total failure of the mechanical system of the aero-engine;


At the end of 1990s, the maintenance records of more than 3000 main shaft bearings of aeroengines and the statistical analysis results of nearly 100 main shaft bearing failures of aeroengines showed that slippage injuries accounted for as much as 39.41% of main shaft bearing failures of aeroengines

Industry Applications

In 2020, global bearing production will reach 150 billion sets.
Smart bearing systematic solutions include: the micro accelerometer based on embedded in the bearing outer ring and after special processing of cage to realize the integration of bearing vibration and rotation speed monitoring, the bearing inner ring and outer ring, rolling body and the breaking of the cage, cage skid, wear, pitting, scratches and other real-time monitoring, fault bearing the full cycle of monitoring. Because of the wear of the bearing rolling element, the rolling element is not simply rolling but sliding, so the bearing cage will produce relative motion inconsistent with the theoretical rotation, so we need to detect the relevant rotation.
TMR Magnetoresistive Sensor for Bearing Cage Speed Monitoring

- Electromagnetic induction principle
- Optical fiber sensing technology
- Ultrasonic velocimetry
- Eddy current velocity measurement technology
- Image recognition technology

- Measuring the speed of the main bearing retainer

<table>
<thead>
<tr>
<th>Feature</th>
<th>TMR Magnetoresistive Sensor</th>
<th>Not sensitive to oil</th>
<th>Not sensitive to harsh environment</th>
<th>Probe</th>
<th>The cage is structurally intact</th>
<th>High sensitivity</th>
<th>Anti-vibration</th>
<th>High temperature resistance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sensitive to fog and oil</td>
<td>×</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Probe collision risk</td>
<td>×</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Structural failure</td>
<td>×</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Can not bear high temperature</td>
<td>×</td>
<td>×</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Don’t resist vibration</td>
<td></td>
<td>×</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sensitive to environment and airflow</td>
<td></td>
<td>×</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Measuring method for speed of aircraft Engine main shaft bearing retainer
TMR Magneto resistive Sensor for Bearing Cage Speed Monitoring

Tunnel magneto-resistance (TMR) based on magnetic tunnel junction (MTJ) consists of a thin insulating layer (a tunnel barrier), sandwiched by two ferromagnetic electrode layers.

TMR magneto resistive sensor exhibits better properties in comparison with Hall, AMR and GMR sensors.

### Table 1 Physical parameters of magnetic sensors

<table>
<thead>
<tr>
<th>Technology</th>
<th>Hall</th>
<th>AMR</th>
<th>GMR</th>
<th>TMR</th>
</tr>
</thead>
<tbody>
<tr>
<td>Powder (mA)</td>
<td>5~20</td>
<td>1~10</td>
<td>1~10</td>
<td>0.001~0.01</td>
</tr>
<tr>
<td>Size (mm)</td>
<td>1×1</td>
<td>1×1</td>
<td>2×2</td>
<td>0.5×0.5</td>
</tr>
<tr>
<td>Sensitivity (mV/V/Oe)</td>
<td>0.05</td>
<td>1</td>
<td>3</td>
<td>20</td>
</tr>
<tr>
<td>Range (Oe)</td>
<td>1~1000</td>
<td>0.001~10</td>
<td>0.1~30</td>
<td>0.001~200</td>
</tr>
<tr>
<td>Resolution (mOe)</td>
<td>500</td>
<td>0.1</td>
<td>2</td>
<td>0.1</td>
</tr>
<tr>
<td>Temperature (℃)</td>
<td>&lt; 150</td>
<td>&lt; 150</td>
<td>&lt; 150</td>
<td>&lt; 200</td>
</tr>
<tr>
<td>Response Time (ns)</td>
<td>&gt; 1000</td>
<td>10</td>
<td>10</td>
<td>0.1</td>
</tr>
<tr>
<td>Temperature Drift (PPM/K)</td>
<td>3000</td>
<td>3000</td>
<td>3000</td>
<td>400</td>
</tr>
</tbody>
</table>
Intelligent Bearing Speed and Vibration Integrated Monitoring

- Precise control the thickness of the magnetic film via micro-nano processing;
- Strong adhesion;
- High service temperature (240 °C);
- Controllable magnetic information (N and S);
- Weak residual magnetic;
- Non-destructive to bearing cage;
- Miniaturization accelerometer;
- Embedded installation;
- Low power and real-time wireless transmission.

The structure of magnetic film and its optical photo
# MEMS Sensor AYDC03-103

## Dynamic Characteristics

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Unit</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sensitivity</td>
<td>mV/g</td>
<td>10±5%</td>
</tr>
<tr>
<td>Range</td>
<td>g</td>
<td>±500</td>
</tr>
<tr>
<td>Resonance Frequency</td>
<td>KHz</td>
<td>≥30</td>
</tr>
<tr>
<td>Frequency Response Range</td>
<td>Hz</td>
<td>1~5000(±3dB)</td>
</tr>
<tr>
<td>Transverse Sensitivity</td>
<td>%</td>
<td>≤5</td>
</tr>
<tr>
<td>Amplitude Nonlinearity</td>
<td>%</td>
<td>≤1</td>
</tr>
</tbody>
</table>

## Electrical Characteristics

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Unit</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Insulation Resistance</td>
<td>GΩ</td>
<td>≥1</td>
</tr>
<tr>
<td>Bias Voltage</td>
<td>V DC</td>
<td>9~14</td>
</tr>
<tr>
<td>Electrical Grounding</td>
<td></td>
<td>Signal Grouding</td>
</tr>
</tbody>
</table>

## Environmental Characteristics

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Unit</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Working Voltage</td>
<td>V DC</td>
<td>18~30</td>
</tr>
<tr>
<td>Working Current</td>
<td>mA DC</td>
<td>4~10</td>
</tr>
<tr>
<td>Working Temperature</td>
<td>ºC</td>
<td>-55~120</td>
</tr>
<tr>
<td></td>
<td>ºF</td>
<td>-67~248</td>
</tr>
<tr>
<td>Shock Limitation</td>
<td>G pk</td>
<td>5000</td>
</tr>
</tbody>
</table>

## Physical Characteristics

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Weight</td>
<td>gram</td>
</tr>
<tr>
<td>Outer Case</td>
<td>40Cr Medium Carbon Steel</td>
</tr>
</tbody>
</table>

![Image of MEMS Sensor AYDC03-103]
The mounting distance of TMR magnetoresistive sensor is about 2.5 mm, while the mounting distance of eddy current sensor is about 1 mm;

The bearing rotating speed from TMR magnetoresistive sensor exhibits linear relationship with the motor speed, and the fluctuation is about ± 0.2% compare to eddy current sensor.
The test difference between the two sensor (a) and the acquisition waveform of the two sensors at 10 kHz (b)

- The measurement fluctuation difference of magnetoresistive speed measuring sensor is smaller than that of eddy current sensor;
- No wave lose was found at a high rotator speed in magnetoresistive and eddy current sensors.
Smart Bearing Vibration Monitoring Experimental Data

(a) Original signal
(b) EMMD decomposition and HHT envelopment of Original signal
(c) Spectrum of EMMD-IMF4 Envelopment

Rotating Frequency: 29.950000
The fault frequency of the outer ring: 107.364760
THANKS FOR WATCHING!

For more product information, please visit www.fatri.cn, or contact our sales representative. Email address: fatri@fatri.cn, Phone: 400-668-6967

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- Bulldozair  Services Category
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- Supraways  Special Prize

- Digital Awards ceremony
- Conclusion by François Davenne

10 December 2019
UIC HQ, PARIS
PROGRAMME

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• Services Category
  • Safety Category
  • Productivity Category
  • Special Prize

10 December 2019
UIC HQ, PARIS
BulldozAIR
Platform for construction project management
BulldozAIR
Expertise in construction tech and software

FOUNDERS
Ali El Hariri – CEO – Ex Manager in Bouygues
Maxence Lerigner – CTO – Digital Entrepreneur

KEY DATES
2012 Founded, 2016 US incorporation
2015 Seed investment, 2019 Series A

KEY NUMBERS
15 people
+30 big account clients

Key partnerships
Investors: Y Combinator (USA), SETEC, Kima Ventures - Xavier Niel, Pascal Casanova (Lafarge)
Incubators: Impulse Partners, UBI France, BNP
Common projects in rail industry

Train stations

Infrastructure

Projects

Construction  Refurbishment

Ongoing

Re-habilitation  Maintenance
Even in most modern projects using digital tools, day to day task management still looks like this: Post-its, Email, spreadsheets.

and of course for smaller projects it’s worse
So we built BulldozAIR: An easy to adopt and all-in-one platform for project management
BulldozAIR at the office

A clear view of construction projects from the office
BulldozAIR on the field
Mobile information gathering, even offline

- Project management
- Localization
- Geolocalization
- Planning
- Notifications
- Photos
- Works tracking
- Forms
- Documents
Traceability and monitoring
The gathered information are analysed, distributed and formatted automatically

Dashboard

Automated reporting
#1 Takes pictures and draw

Collect information on field, even off line
#1Bis Fill technical forms

Collect information on field, even off line
#2 (Geo) Locate your tasks

Locate on plans or geolocate all your field observations
#3 Collaborate with everyone on the project

Attribute precise tasks to a specific project member
#4 Back to office – Back to Data

## Boucicaut

<table>
<thead>
<tr>
<th>Tag</th>
<th>Notes</th>
<th>Progress</th>
</tr>
</thead>
<tbody>
<tr>
<td>Administrative</td>
<td>1</td>
<td>100% À faire</td>
</tr>
<tr>
<td>Contrôle qualité</td>
<td>12</td>
<td>42% À faire, 17% À, 42% Terminé</td>
</tr>
<tr>
<td>Électricité</td>
<td>4</td>
<td>50% À faire, 50% Terminé</td>
</tr>
<tr>
<td>Équipement</td>
<td>2</td>
<td>50% À faire, 50% Terminé</td>
</tr>
<tr>
<td>Générateur électrique</td>
<td>3</td>
<td>100% À faire</td>
</tr>
<tr>
<td>Livraison</td>
<td>7</td>
<td>43% À faire, 29% À valider, 29% Terminé</td>
</tr>
<tr>
<td>Opl</td>
<td>1</td>
<td>100% À faire</td>
</tr>
</tbody>
</table>
#5 Monitor your projects
Once you leave the field, your report is ready.
Benefits

A strong interest for every project member

**Project Manager**
- Global view of project
- Traceability and monitoring of actions
- Standardization of processes
- Notifications

**General contractor, Project Manager Assistant, Design Office**
- Reduced visitation time
- Automated reporting
- Enhanced monitoring

**Companies, Contractors**
- Clear list of tasks to carry out
- Access to all documents and plans
Use cases
Scope of use of BulldozAIR: project management from A to Z

- **Pre-project**
  - Initiation
    - Control plan
    - Inventory / inspection
    - Site audit
    - Milestone tracking

- **Project**
  - Execution
    - Follow-up and management of progress
    - Site meeting

- **End of project**
  - Punch list review
    - Proof of invoiced services
    - Traceability
    - Record of finished work

- **Post-project**
  - Exploitation
    - Tracking of works
    - On-site interventions
Our clients
Owning or operating real estate or industrial assets

Their partners
INFRASTRUCTURE

METRO and RER network
RAIL network
AUTOROUTIER network
Civil engineering
Airports
Urban networks
Some references in Infrastructure and transports

Prolongement du Tram T3

**Paris**
- **Longueur** : 4,3 kilomètres
- **Donneur d'ordre** : Mairie de Paris
- **Maîtrise d'œuvre** : SETEC
- **Budget** : 211 millions d'euros

Prolongement de l'autoroute A16

**L’Isle-Adam-Frontière Belge**
- **Longueur** : 8 kilomètres
- **Donneur d'ordre** : Sanef
- **Maîtrise d'œuvre** : Setec
- **Budget** : 210 millions d'euros

Projet Férroviaire Contournement Nîmes-Montpellier

**Nîmes-Montpellier**
- **Longueur** : 80 kilomètres
- **Donneur d'ordre** : OcVia
- **Maîtrise d'œuvre** : SETEC
- **Budget** : 1,757 milliards d'euros
BulldozAIR
PROGRAMME

_UIC digital Awards 2019_ (Presentations of their projects by the selected startups)

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- National Engineering Laboratory  
- Supraways  

- Digital Awards ceremony  
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10 December 2019
UIC HQ, PARIS
Intelligent Operation and Maintenance System of High-speed Railway Permanent Way Based on Big Data

National engineering laboratory of comprehensive transportation big data application technology
Agenda

01 Introduction
02 Total solution
03 Effect and prospect
Deeply mining data value using big data and AI technology to improve operation and maintenance productivity

Separate data analysis,
Only 10% of the data value is mined

10%

Apply of big data and AI technologies,
The hidden 90% of the data value is mined

90%

Intelligent Operation and Maintenance System for High-speed Permanent Way Based on Big Data

analysis
analysis
analysis
analysis
analysis
analysis
Intelligent Operation and Maintenance System for High-speed Railway Permanent Way Based on Big Data
2.1 State evaluation of permanent way equipment based on whole datalink

Synthesis analysis of dynamic detection data

Synthesis analysis of dynamic detection and settlement data

Dynamic superposition analysis

Track state evaluation

The chart of TQI changes from August 2018 to August 2019 at 2.4 km

Mileage

Evaluate the actual state of equipment
Guide on-line maintenance
2.2 Prediction of equipment variation trend based on big data

- Trend Prediction
- Compare predicted value with actual value
- Precision >97.74%
- MSE<0.03
2.3 Flaw classification and correlation knowledge graph of permanent way

人工检测

无砟道床

道床及外观

标志标记

密贴

钢轨

联络零件

几何尺寸

工电联合(高速区段)

道岔区板式无砟道床侧面局部块松脱、缺损或剥落

水硬性沥青砂浆填充层、自密式混凝土层

CRTS II型板式无砟道床板间接缝脱开、缺损或剥落

CRTS II型板式无砟道床板间接缝脱开

混凝土枕内

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混凝土枕内

注浆孔凸起

注浆孔径

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混凝土枕内

注浆孔堵塞

注浆孔胶

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混凝土枕内

砂浆填充层泛白

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CRTS II型板式无砟道床板间接缝脱开

混凝土枕内

水泥碳化沥青砂浆填充层、自密式混凝土层、缺损或剥落
2.4 Decision making of project approval and budget estimate of permanent way renewal and overhaul project

Duplicate project

Discover unreasonable projects
Indicate the need of project
2.5 Recognition and display of abnormal change of permanent way equipment based on electronic map

<table>
<thead>
<tr>
<th>Mileage coordinates</th>
<th>Call map service</th>
</tr>
</thead>
</table>

- **Bridge equipment condition monitoring and trend analysis**

- **Track smoothness state and trend prediction**
3. System application effect

After System Application

- Data quality has been significantly improved. Distributed processing has increased data processing time by nearly five times.
- It supports full-type data retrieval, and its retrieval efficiency has been improved by nearly a thousand times.

- The accuracy of equipment state estimation is increased from 82% to 90.
- The decision time is compressed from a few hours down to a few minutes.
Our Team:
National engineering laboratory of comprehensive transportation big data application technology
Focus on big data application technology for integrated transportation (especially railways) to solve transportation decision problems.

Team Members:
Wang Tongjun, Li Ping, Wu Yanhua, Ma Xiaoning, Cheng Zhibo, Zhao Xinxin, Dai Chunping, Zhao Zhengyang, Zheng Jinzi, Xiao Xin, Feng Boqing, Liu Yanjun, Dai Mingrui, Wu Wei, Xu Wenya
PROGRAMME

*UIC digital Awards 2019 (Presentations of their projects by the selected startups)*

- Bulldozair  
- Cylus  
- National Engineering Laboratory  
- Supraways

- Digital Awards ceremony  
- Conclusion by François Davenne
Smart urban mobility
Autonomous, rapid & sustainable
City expectations in a hyper-urbanization context

Endless urban growth

Congestion & pollution records

Under-performing conventional public transit modes

> 50% → > 70%

Limited resources for the planet and the cities

Sustainable transportation needs

Smart cities need smart and sustainable urban mobility!
Supraways: a sustainable public transit mode for passengers and freight

Network of interconnected loops, no waiting time

Aerial mode, free ground space, fast prefabricated construction

Off-line stations, Direct trips

On-demand Trips, 24/7

V2X communication system Smart fleet management

Electric vehicle Clean energy

Passenger vehicle 7-9 passengers

Freight vehicle 1,5 t
Current city situation all over the world

- P+R undersized by lack of land
- Congestion
- Urban center saturated
- Periphery: constrained and limited mobility
- Star structuring urban transport
Supraways network implementation

- Supras double track
- Supras one way
- Supras stations
- Intermodality with existing TC
- Extra-urban logistics hubs
- Urban logistics hubs
- Waste / incinerator
- Waste collect
- Intercity line

P+R more capabilities

Fast logistics last mile

Reduced congestion

Decrease of pollution

Waste collect
Supraways: the game changer for urban mobility
Main competitive advantages

**SPEED & COMFORT**

- **Urban**
  - 50 km/h
  - 80 km/h in a straight line
- **Intercity**
  - 100 km/h
  - 130 km/h in a straight line

**HIGH CAPACITY SYSTEM**

- **Passengers per hour and per direction**
  - 5,000 – 10,000

**TOTAL COST OF OWNERSHIP HIGHLY COMPETITIVE**

- **Investment cost** M€ / km all-included:
  - 6 M€
  - 8 M€
  - 15 M€
  - 15-20 M€
  - 20 M€
  - 25 M€
  - 50 M€
  - 100 M€

- **Operation & maintenance cost** < 50% classic TCU
  - No driver, speeds, efficiency and energy consumption

**DIVERSIFIED REVENUE MODEL**

- **Passengers**
- **Logistic**
- **Rental of surfaces**
- **Waste**
- **Marketing**
- **Public services**
- **Other services**

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Major innovations

**TECHNICAL INNOVATION**
Auto-directive bogie

![Auto-directive bogie](image1)

- Electric propulsion
- Embedded switching system
- Suspension intelligence

**TECHNICAL INNOVATION**
Autonomous vehicles

![Autonomous vehicles](image2)

- Centralized control and communication system

**SOCIAL INNOVATION**
Public MaaS

![Public MaaS](image3)

- Comfortable, safe and on-demand public transit

**URBAN INNOVATION**
Re-design the city

![Re-design the city](image4)

- Urban green corridors
Commercial pipeline: a growing interest for Supraways technology

The 1st WW demonstrator JO 2024
Network studies phase
Start studies
Submitted offers
Saint-Quentin-Yvelines, the first worldwide demonstrator

- 7 Stations
- 5,9 miles
- 4,7 miles double track
- 1,2 miles One way
- 7 Min Station SQY - Oméga
- 85 vehicles
- 3 Olympic sites
- 24 000 trips/day
- 6 M trips/year
- Éq. 6,3 M Car trips/year
- Ready for Paris 2024
- 4,7 miles double track
- 1,2 miles One way
- 7 Min Station SQY - Oméga
- 85 vehicles
- 3 Olympic sites
- 24 000 trips/day
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- Éq. 6,3 M Car trips/year
- Ready for Paris 2024

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Paris in 2040: Supraways backbone network

Supraways Network
- 2 x 4 ways
- 2 x 1 or 2x2 ways

Towards La Défense
Towards Saint-Denis and CDG Airport
Towards Rosny
Towards Créteil
Towards Versailles et SQY
Towards Orly airport
Paris in 2040: example of extension around La Défense

- Fine service and Defense-Communes links
- Project « Allée de Neuilly »
- Strong axis Province-Paris
- Nanterre la Boule
- Nanterre-Université
- Gare de la Garenne-Colombes
- Supras P+R
- Réseau Supraways:
  - 2 x 4 ways
  - 2x1 voie ou 2x2 ways
  - One way
Contact

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Thanks for your attention
Thank You