



SURFO

Surveillance par fibre optique

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Outline

0. Institutional presentation

1. Context

2. The SURFO program

3. Scientific results

4. Perspectives

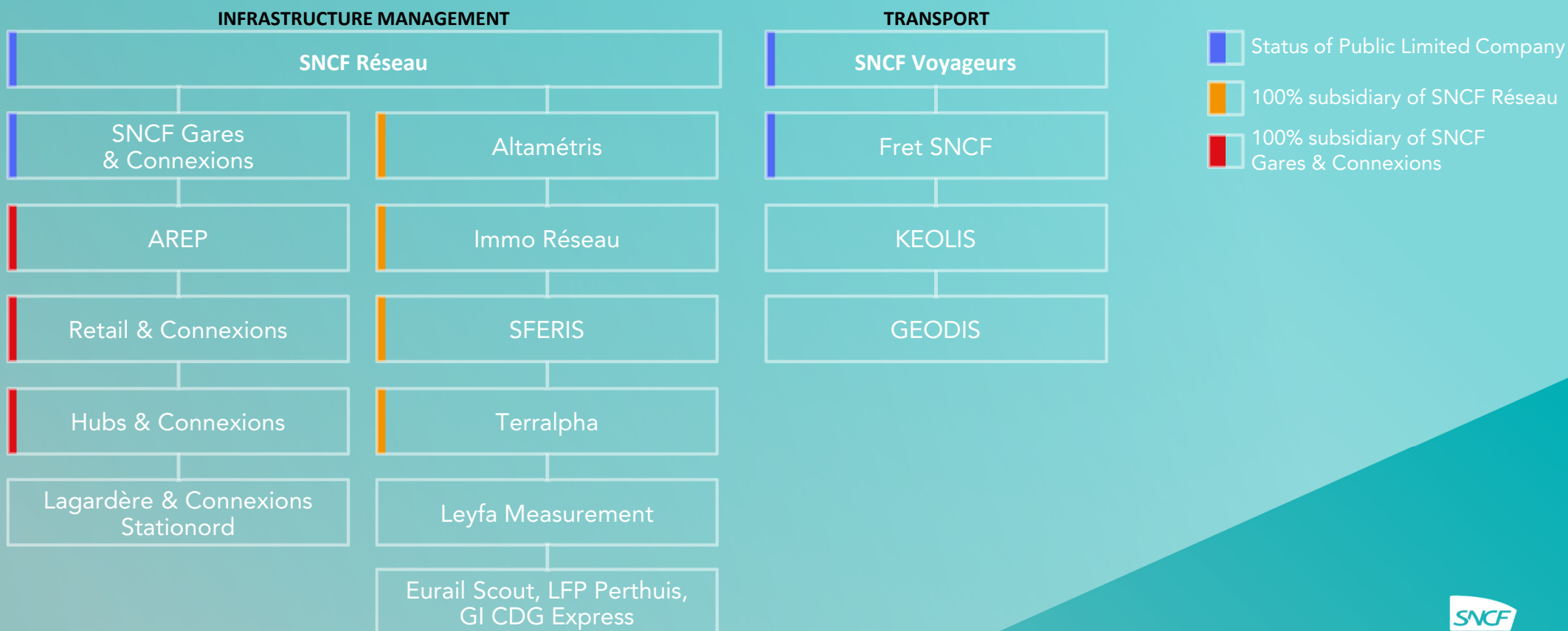


Missions, key figures & organisation



Our organisation

The SNCF Réseau ecosystem





Our course for 2030

Make SNCF Réseau
a high-performing company
committed to serving
its customers and regions

The pillars of our strategy



Satisfaction and customer relations

Think customer first and be recognized as a committed and reliable partner



Safety, security and ethics

Consider safety in operations and the workplace as a prerequisite in all we do



Satisfaction and commitment from employees

Become an employer that trusts and empowers its employees



High-quality production and service

Accelerate digitalization to meet the demand for efficiency and quality in production



Economic and commercial performance

Strive with determination to achieve financial break-even by 2024



Territorial and environmental commitment

Be a driving force in the ecological transition and strengthen our proximity in each region

Europe, a natural extension of the SNCF Réseau playing field

SNCF Réseau participates in the development of the European railway network at various levels. In terms of international policy, the company has three main objectives:

1 Develop international rail traffic solutions

By 2030

- **x2** high-speed rail traffic throughout Europe.

By 2050

- **x2** rail freight traffic and build a fully operational, multimodal Trans-European Transport Network (TEN-T) for sustainable and intelligent mobility, ensuring very fast connections.
- **x3** the number of passengers.
- **Carbon neutrality.**

2 Build a fully interoperable European rail network

3 Optimise the performance of the European railway system

2023 in figures

28,000 km

of lines in operation
including 2,700 km of high-speed lines



250,000
tonnes
of freight
transported
every day



3 billion €
devoted to
regeneration work

975 km
of tracks
renewed
every year



5.5
billion €
of gross investments

15,000
trains every day



95%
of rails recycled
5% reused



5 million
passengers
every day



3,000
stations and
halts



39%
reduction of indirect carbon
emissions as a result of the
circular economy

7.5
billion €
sales
for the group
SNCF Réseau



62 customers
including railway companies
and authorised applicants

25,700 m²
of photovoltaic
panels installed

01

Context of SURFO

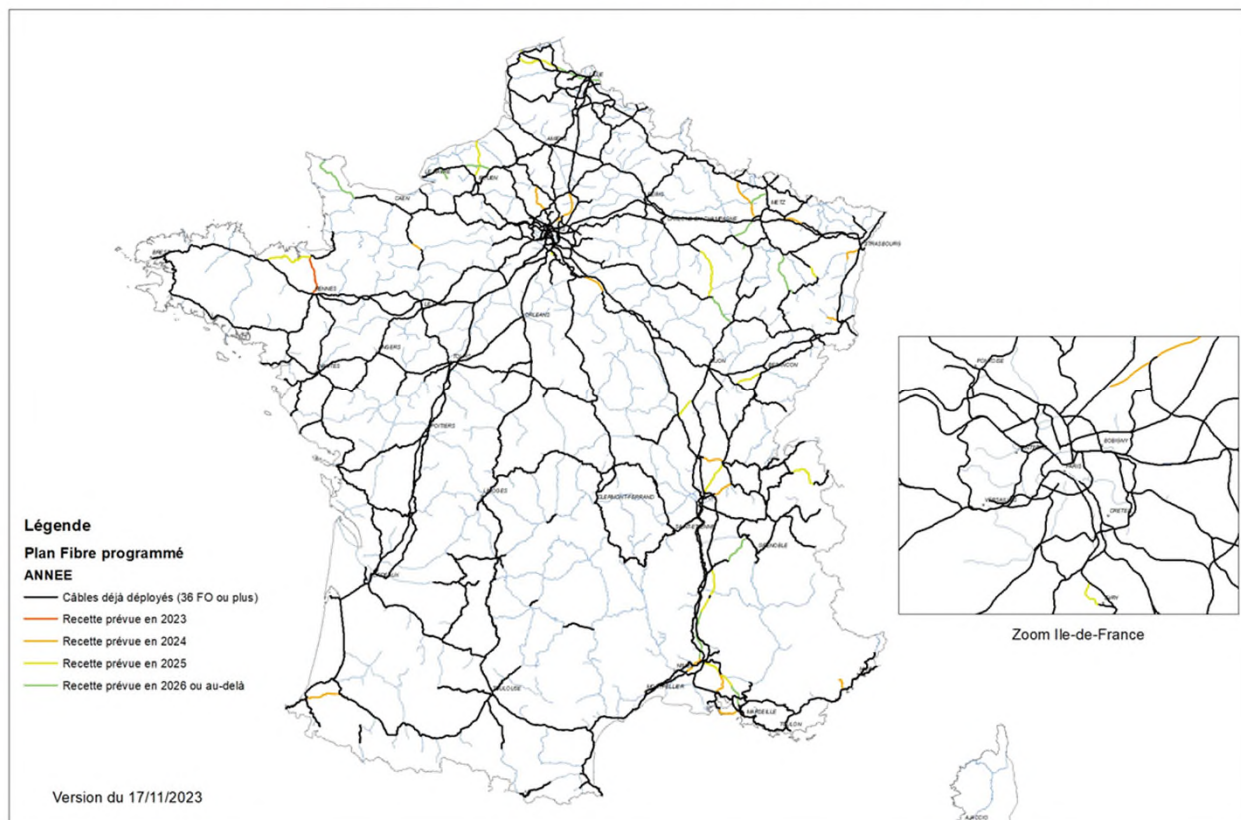
CONTEXT



- Accident in the SW of France in 2012:
 - Undetected rockfalls
 - Train derailment
- Authorities' recommendations :
 - Need of new detection means
- Distributed Acoustic Sensing (DAS) :
 - Using Fiber Optics to detect vibrations

DAS TECHNOLOGY : WHY ?

Câbles optiques existants et en projet SNCF Réseau (Plan Fibre et projets régionaux)



- We use already installed fibers
 - **One dark fiber**
- We take advantage of existing fiber network
 - **More than 28 000 km**
- No additional installation
 - **Cost saving**

DAS TECHNOLOGY : WHY ?



- Connection of the interrogator at only one end of the fiber
 - **Easy to install**

- The vibration can be located
 - **Precision of few meters**

- One unit can monitor tens of kilometers of tracks
 - **Long range detection**

COMMUNICATION VIDEO

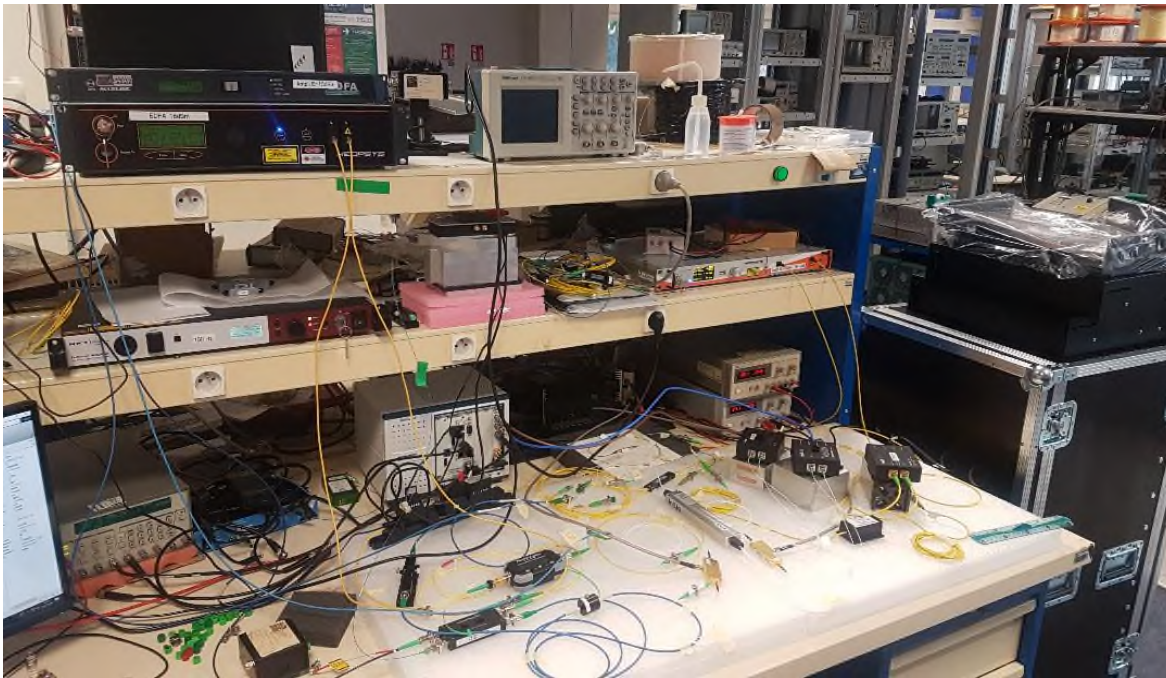
20 mars 2024

02 The SURFO program

12 Juin 2024

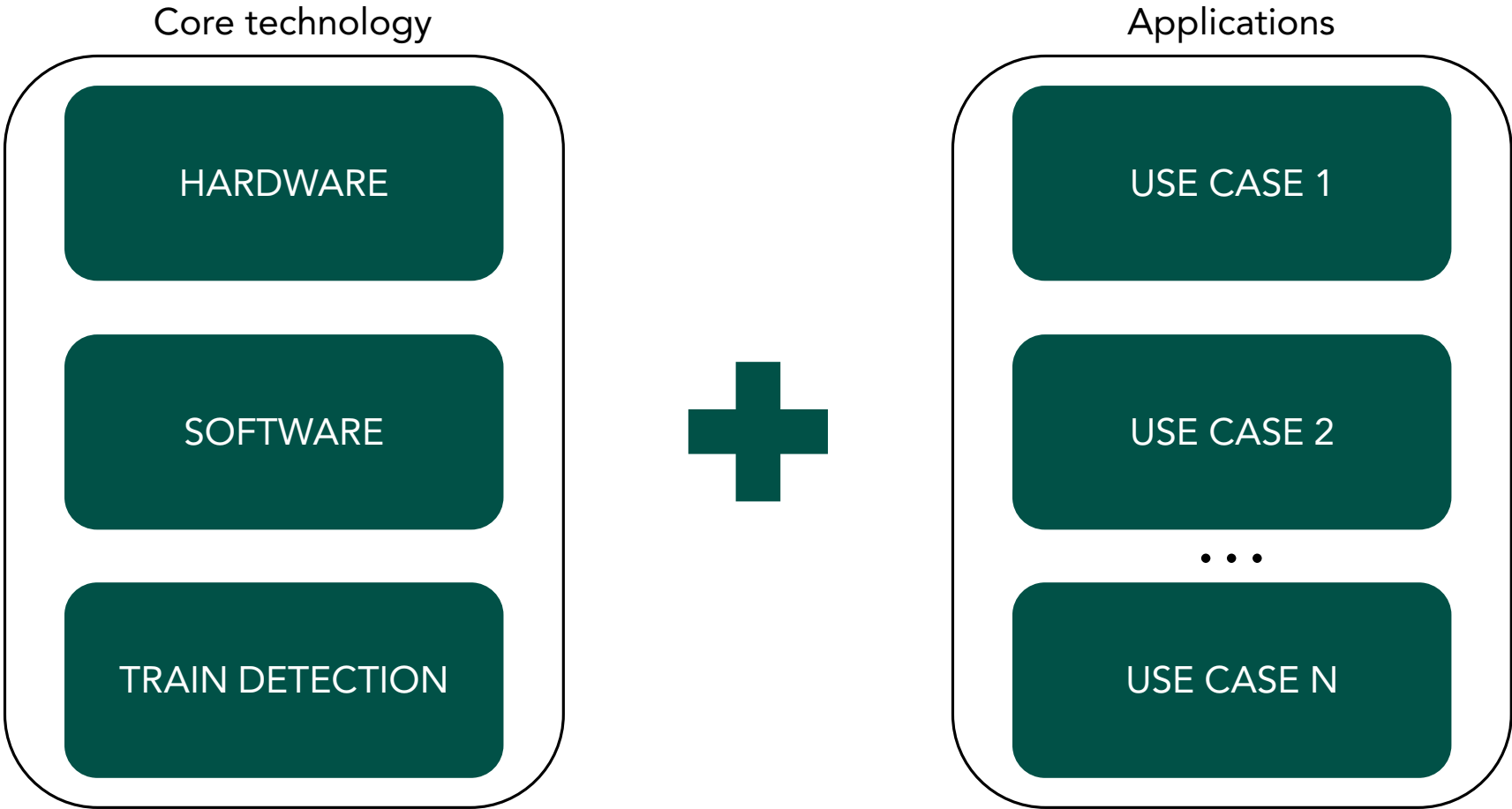
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THE BEGINNING



- Need of a deep understanding of the technology
- Development of a first lab prototype
- Control of all parameters
- Can be customized for railway applications

STRUCTURE OF THE PROJECT



CORE TECHNOLOGY : HARDWARE

2 prototypes already installed



High speed line



Train Detection



8 more expected, including :

Broken rail

Ground monitoring

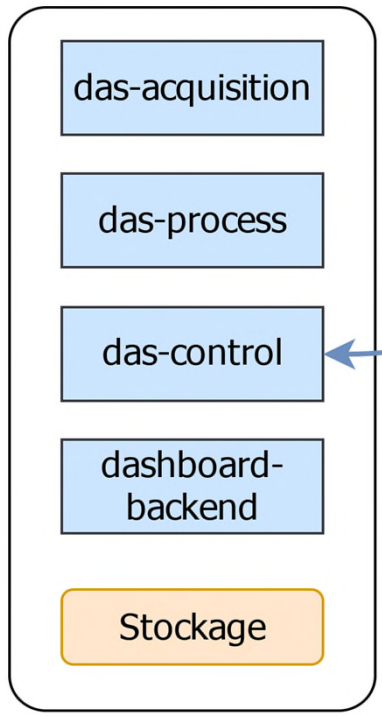
Bridge monitoring

Rockfalls

pre-industrialized interrogators will be outsourced (2024)

CORE TECHNOLOGY : SOFTWARE

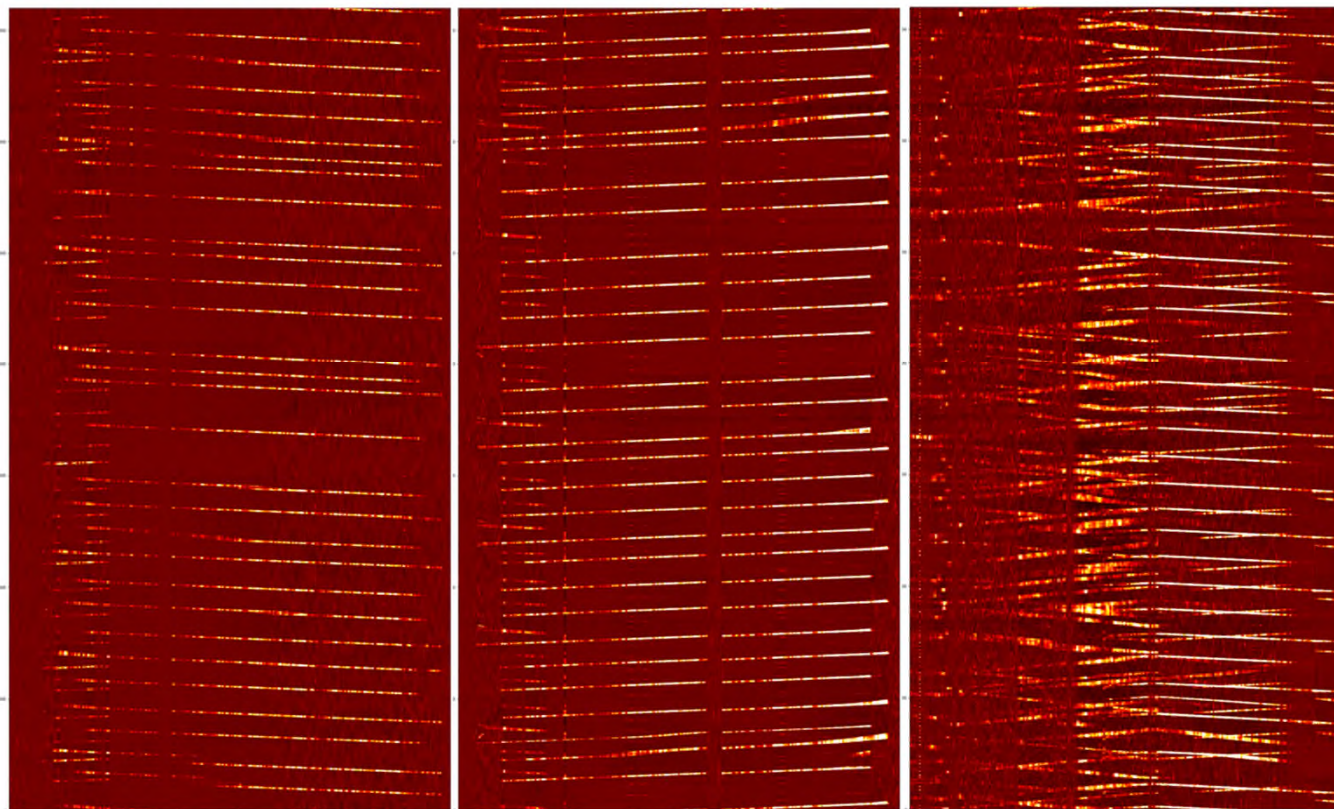
SURFO (DAS) #1



- Total remote control of the dual fiber interrogator
- Pre-processing and display of the data
- Future works are needed especially for IT system integration

AUTOMATIC TRAIN DETECTION

2H RECORDING AT PARIS RER E



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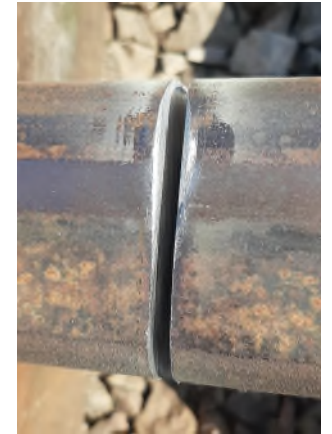
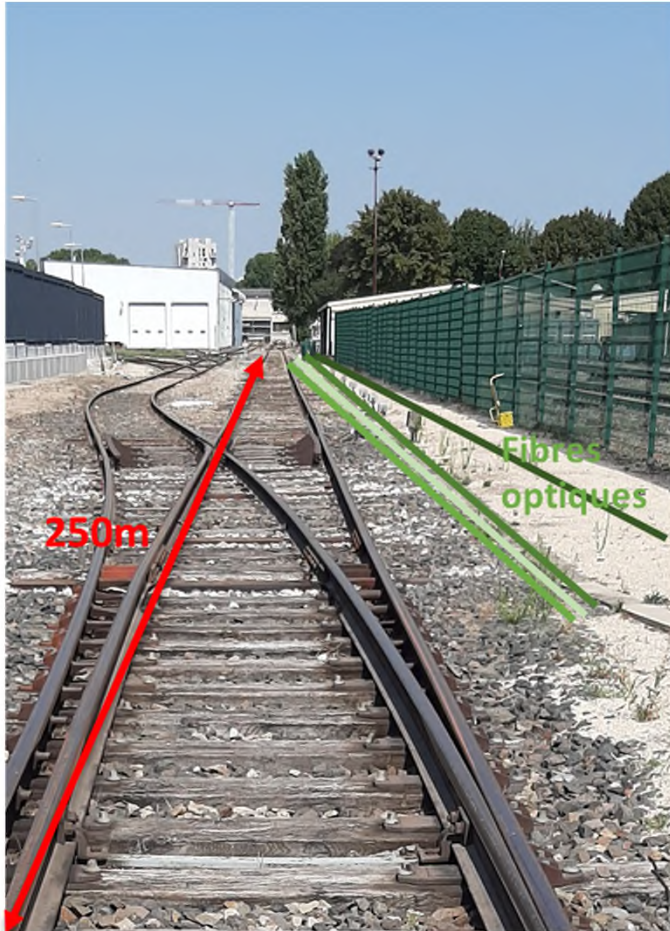
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03 Scientific results

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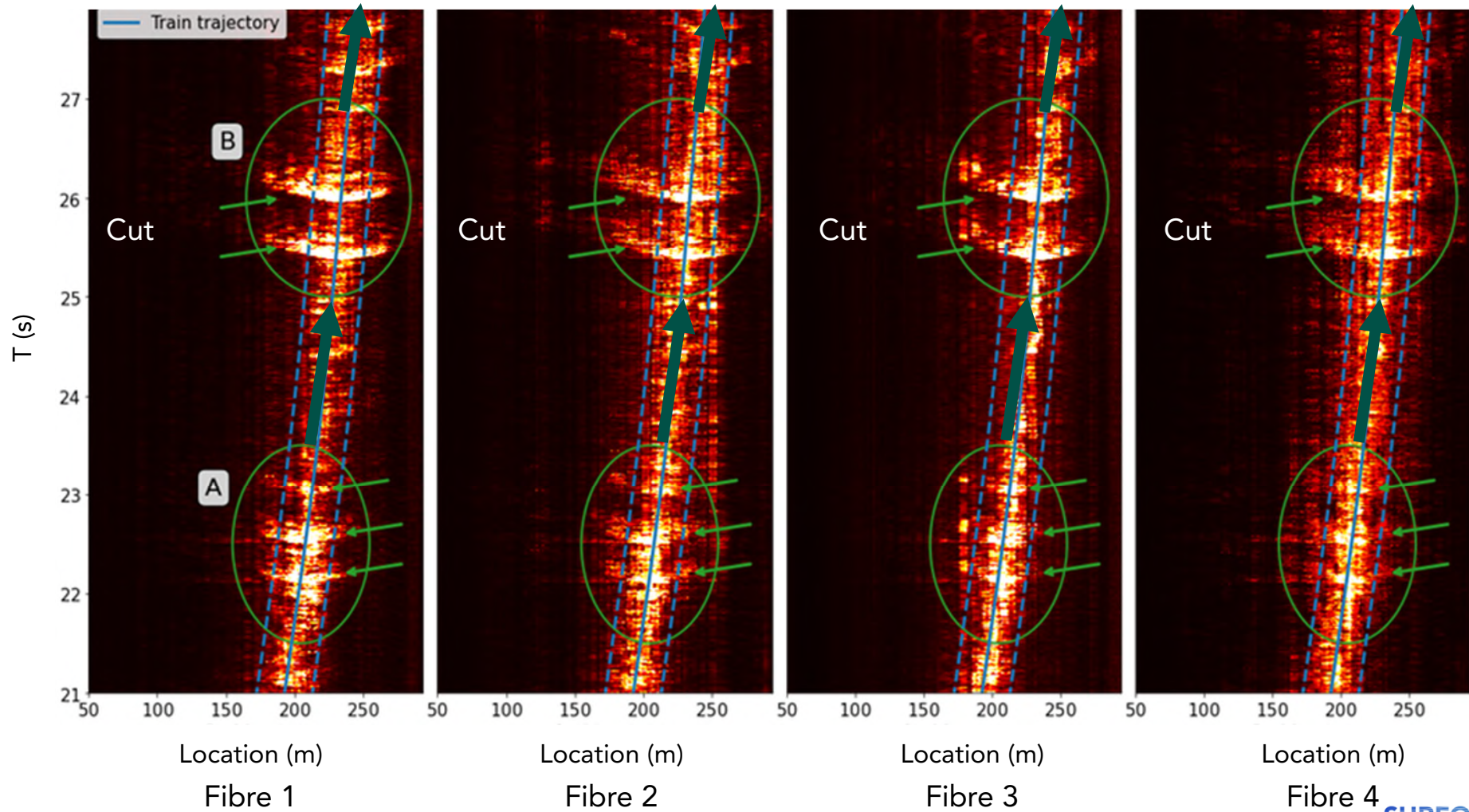
BROKEN RAIL PoC



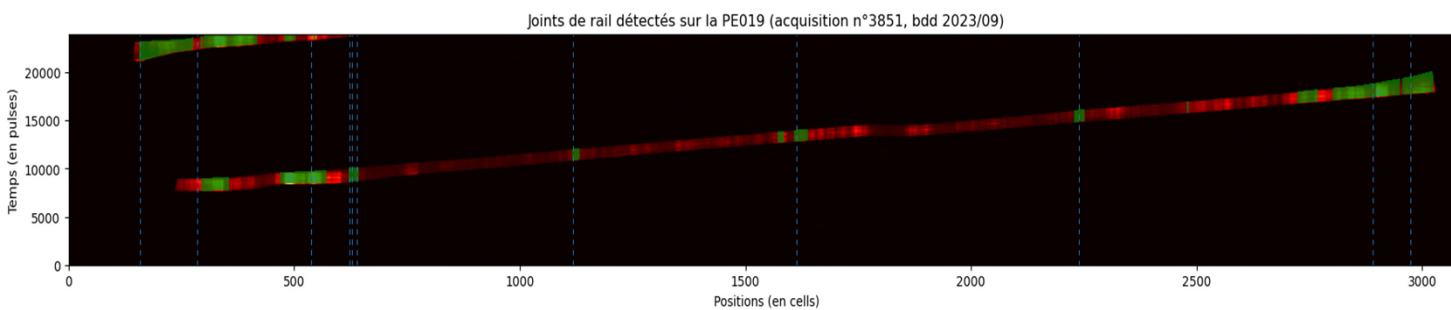
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TRAIN PASSES ON BROKEN RAIL

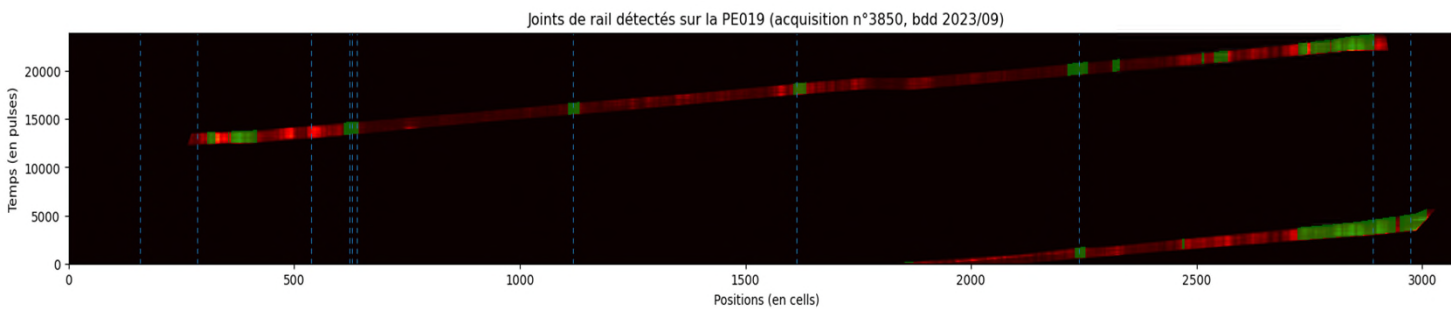


BROKEN RAIL DETECTION

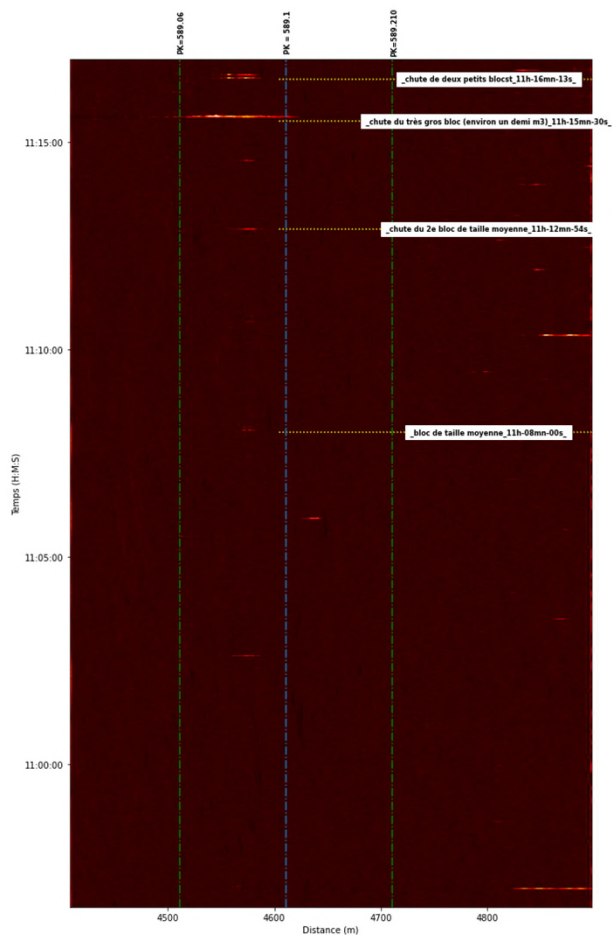


Detecting performance :

	Accuracy	Precision	Recall	F1-score
SVM	0.906	0.91	0.90	0.91
XGBoost	0.927	0.93	0.93	0.93



ROCKFALLS



04 Perspectives



OTHER USE CASES

1. Infrastructure monitoring:

- Detecting broken rail
- Monitoring bridges vibration

2. Detecting/monitoring external “threats” :

- Intrusion detection
- Cable theft
- Rock-fall detection

3. Train monitoring

- Detecting moving rolling stocks
- Detecting train parameters, such as train speed and length
- Identifying rolling stock

FIBER OPTICS

For sensing we are using standard SNCF monomode telecom FO cables...

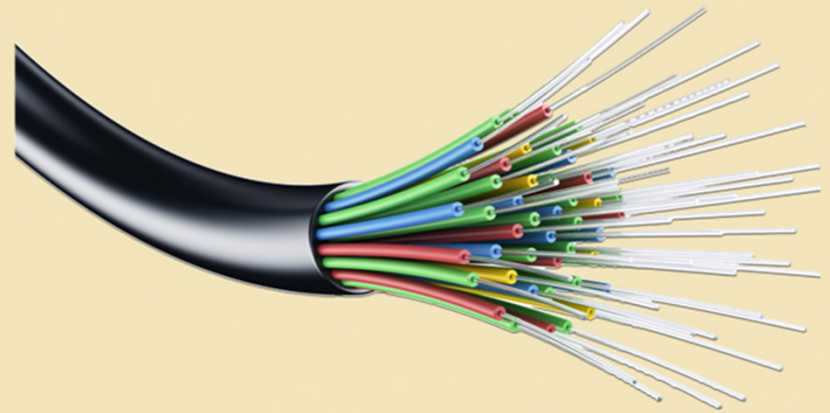
... but:

- SNCF still deploys hundreds of km of cables every year → a current goal is to install FO in many small railway lines
- SNCF could integrate in the FO cables a specific FO enhanced for sensing
- SNCF could install cables whose structure is more appropriate to sensing
- In specific situations, SNCF could install a FO enhanced for sensing as a patch of an existing FO cable (in order to not reduce the max distance)

THANK YOU



Ceci n'est pas une pipe



*Ceci n'est pas un
équipement télécom*

Annexes

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L'INTERROGATEUR DAS

