**PREDICTIVE MAINTENANCE
OF RAILWAYS VIA DRONES**

V2.2

FRÉDÉRICK VAUTRAIN, Société VISEO

> Experienced Director Data Science with a demonstrated history of working in the information technology and services industry. Skilled in Industry, E-commerce, Statistical Modeling, Big Time series, Entrepreneurship, and Data Science Management. Strong research professional graduated from PhD Maths Appli Université Dauphine - HEC Paris Challenge +

> **Linked-in :** https://www.linkedin.com/in/frédérick-vautrain-175552/

GUILHEM VILLEMIN, SOCIÉTÉ ALTAMETRIS

› Guilhem Villemin, docteur ingénieur centralien, s'appuie sur son expertise dans le domaine du Traitement du Signal et des Images, reconnue au sein d'un large réseau (Ecoles, Universités, Laboratoires, Entreprises, Collectivités). Il a pu élargir son champ de compétences au design de système de diagnostic et au Système Ferroviaire, plus focalisé sur la Surveillance et la Maintenance. Dans le cadre de ses missions, il a développé une expertise intégrée au monde ferroviaire en vision industrielle, les systèmes de mesure et sur l'usage des drones. Aujourd'hui CTO d'Altametris, il pilote l'ensemble des programmes de R&D de la société, pour le développement d'applications et de systèmes.

› **Linked-In :** https://www.linkedin.com/in/guilhem-villemin-71b97b8a

VINCENT THAVONEKHAM, Société VISEO
Microsoft Regional Director & Microsoft MVP Azure

Speaker – dont keynote 15000 participants
durant MS Experiences, avec VP Exec MS Corp

www.thavo.com

@vThavo

Expertise Azure reconnue jusqu'à Seattle !

2017/18: **Microsoft Regional Director**
2015,16,17,18, 19: Azure MVP Award
2015: MS p-Seller **Azure + DevOps + Data/AI**
2015: WPC Orlando: Top 5 best pSeller Fr
2013-2015 : Microsoft vTSP Azure

CERTIFICATIONS / DEGREES:
- PgD & MSc IT in Intelligent Systems
(distinction & 1st rank) ; BEng Honors
- ITIL v3, PRINCE2, ScrumMaster,
- Microsoft Certified Professional

Author & co-author : DevOps & Azure
(France & international www.aka.ms/aiplaybook)
- Published books, white paper & magazines
- Round Table panels including live streaming
(Gene Kim, Best seller 'The Phoenix project')

Activités chez VISEO
- Responsable du partenariat Microsoft France et Corp
- Partenaire OPC UA (standard mondial IoT industriel)
- Etablissement de stratégies pour obtenir les médailles :
  . Microsoft Gold Partner
  . **N°1 monde en « Azure IoT Central »**
  . N°1 France en Microsoft AI
  . **Acteur majeur en Azure IoT en France et IoT Edge**
  . Co-écriture livres MS Corp
- Missions d'audit / Conseil
- PoC Innovants en IoT Edge et AI et Quantique

Microsoft Regional Director:
Nommé par Microsoft Corp à travailler sur la stratégie sous NDA de Microsoft Corp et ses clients clefs.
Cercle fermé limité à 500 individus dans le monde

PREDICTIVE MAINTENANCE - BACKED BY OUR EXPERTISE IN ARTIFICIAL INTELLIGENCE

analysis
Better knowledge and understanding of your data, closer to similar profiles, reduced number of variables

interpretation
Interactive visual representation, abnormal behavior detection, sorting of data in defined classes

prediction
Analysis, advanced mathematical modelling and forecasting (rare events, evolution of values in time...)

technology
Optimization of data processing, architecture, collection infrastructures

MAINTENANCE

❯ Predictive maintenance

- minimize the number of unexpected breakdowns and maximizing asset uptime which improves asset reliability

- reduce operational costs by optimizing the time you spend on maintenance work (in other words, doing maintenance only when you need to do it practically eliminates any chance of you wasting time doing excessive maintenance)

- improve your bottom line by reducing long-term maintenance costs and maximizing production hours

REACTIVE

Fix when it Breaks

PREVENTIVE

Maintain it at regular interval

PREDICTIVE

Predict exactly when it will break

Prescriptive

Identify lever for action to avoid predictive failure

DATA FOR MAINTENANCE PREDICTIVE/PRESCRIPTIVE

› Predictive maintenance: using condition-monitoring sensors

Image / video	Vibration	Temperature	Pressure	Sound	Oil

DATA FOR MAINTENANCE PREDICTIVE/PRESCRIPTIVE

> Predictive maintenance: using condition-monitoring sensors

Image / video　　**Vibration**　　**Temperature**　　**Pressure**　　**Sound**　　**Oil**

> Prescriptive maintenance: using condition-monitoring sensors + external data

Machine Type　　**Work order**　　**Climate**　　**Usage traffic**　　**Raw Material**

DATA FOR MAINTENANCE PREDICTIVE/PRESCRIPTIVE

> Predictive maintenance: using condition-monitoring sensors

Image / video **Vibration** **Temperature** **Pressure** **Sound** **Oil**

**DATA SCIENCE
&
ARTIFICIAL
INTELLIGENCE**

> Prescriptive maintenance: using condition-monitoring sensors + external data

Machine Type **Work order** **Climate** **Usage traffic** **Raw Material**

ARTIFICIAL INTELLIGENCE: TWO SCENARIOS

Adequacy between the available information and the use case

> Detect precisely a phenomenon

> Explain a phenomenon to identify leverage

Use cases ⟷ **Algorithm**

> Neural networks- Deep learning

> Modeling-regression

Data

Detect which insulator has default

Many images to collect and annotate for **to learn**

Why is a metal plate defective?

95.3 % are considered as valid Shapes
Valid Picture

73.37 % of Valid Shapes
Invalid Picture
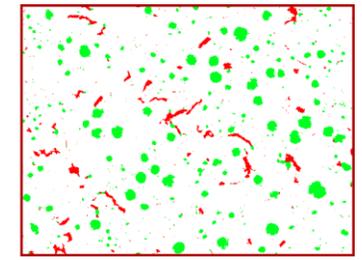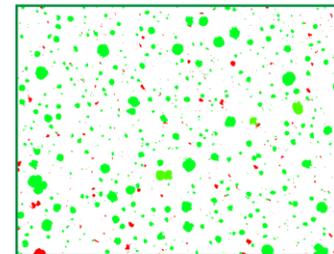
Few images needed: **Modeling** Forms

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OUR APPROACH

Collaborative and iterative

FRAME

- Context understanding
- Identification of scenarios on the components to implement
- IT environment
- Scope of the project
- Success Criteria
- Planning and main hypothesis for Next Steps

COLLECTE/EXPLORE

- Exploratory analysis in the Lab to test the value of the data.
- Produce feature Engineeringenrichment & selection),
- Test and train several Models and keep the best,
- Datavisualisation development

SCALE

- Extension of the use case and the model beyond its initial Perimeter
- Industrialization of the production of analyses and recommendations.

PERFORM

- Supervise and monitor the decision-making system and Associated Models
- disseminate information and actions throughout tea Organization and ensure Adoption.

❯ **START SMALL**
To Secure the economic impact and return on investment of thesis projects;
Quickly detect the lack of value.

❯ **THINK BIG**
Aiming for an industrializable Device by design.

AI is an old story

———

WHY this hype ?

ARTIFICIAL INTELLIGENCE / INTELLIGENT EDGE

➔ . EXEMPLE OF THE « MARKETING » HYPE

. WHAT IS IT ?

. WHY ?

. HOW ?

Cercle de confiance Numérique des Industries Stratégiques

VISEO on Keynote

- Event of 15000 people over 2 days

- It is a 10 000 m^2 event

- Theater of 4000 people

- 200 000 people connected on Live TV

- VISEO : IoT & AI on Julia White' keynote (Vice-President Corporate Microsoft Azure worldwide).
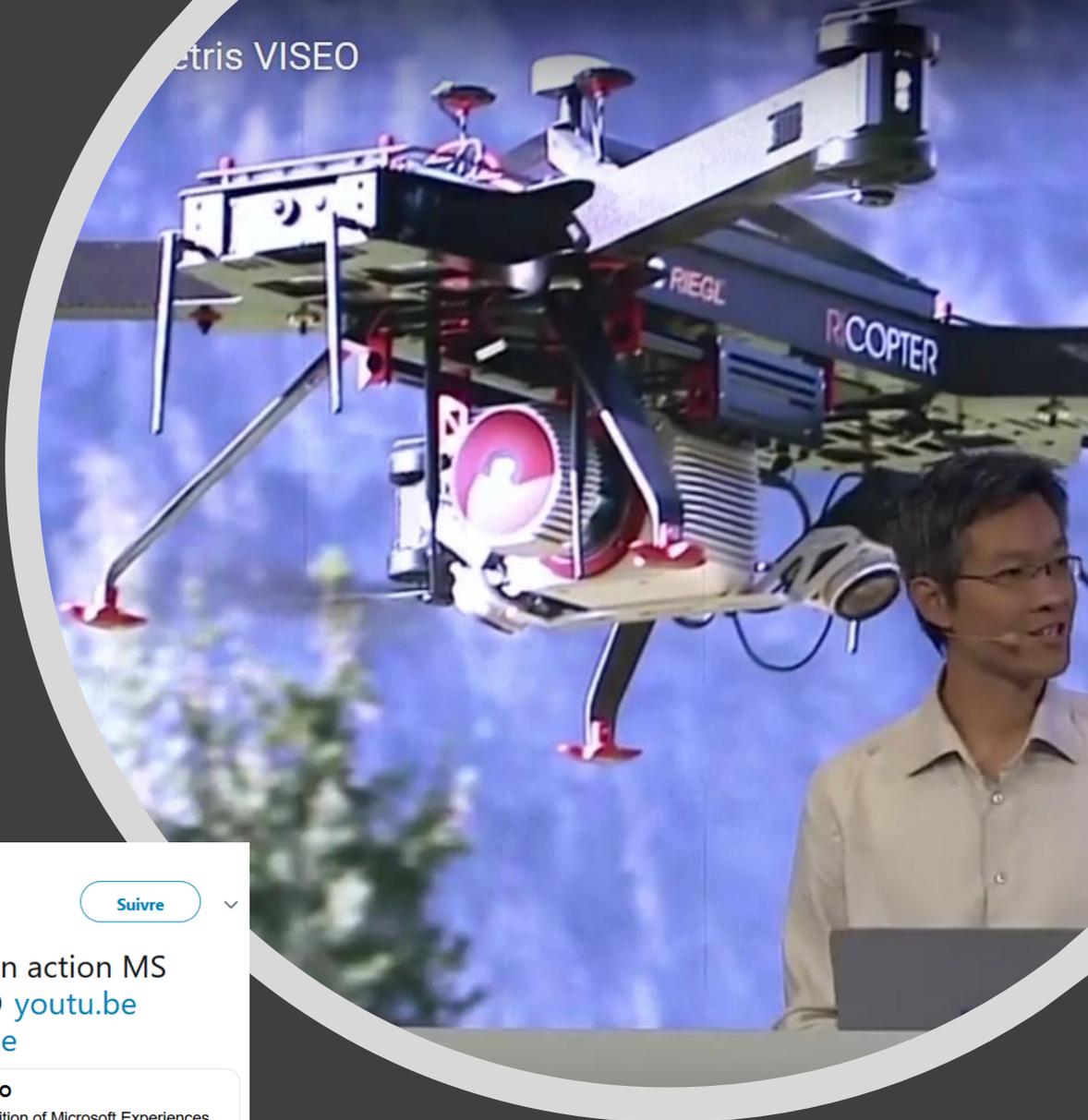
Ranga Vadlamudi
@RangaVadlamudi

Principal Program Manager Microsoft Azure IoT Engineering. #Microsoft #Azure #IoT. Simplicity is the ultimate sophistication.

⌖ Redmond, WA

🔗 microsoft.com

Ranga Vadlamudi
@RangaVadlamudi
Suivre ⌄

Pretty cool!! #azureiot edge in action MS Experiences Altametris VISEO youtu.be /uC6skEWqgdg via @YouTube

MS Experiences Altametris VISEO
VISEO was present at the 2018 edition of Microsoft Experiences, represented by Vincent Thavonekham, our Microsoft Regional Director & MVP Azure, who spoke at...
youtube.com

17:00 - 2 févr. 2019
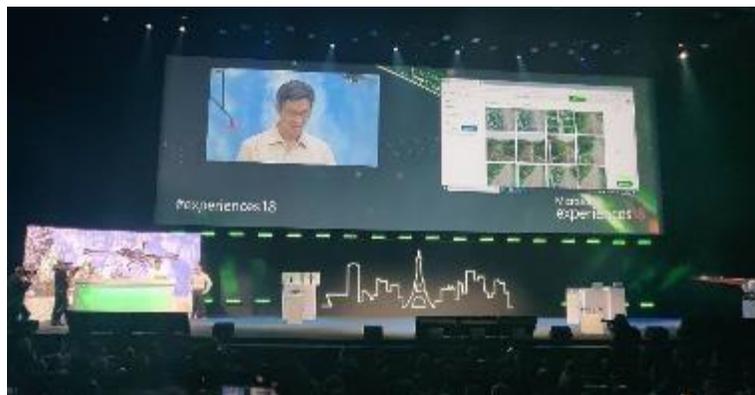
VISEO & ALTAMETRIS
ALTAMETRIS, UNE SOCIÉTÉ DE SNCF RÉSEAU
SNCF

AI + IoT + 'Intelligent Edge'

Vincent Thavonekham, MVP, MS Regional Director
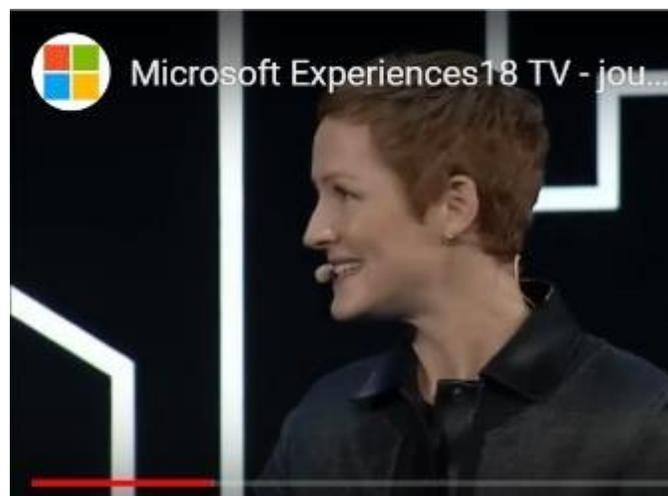
Julia White Keynote, VP corp Azure worldwide 4000 attendees, 200000 on LiveTV. Video
https://youtu.be/uC6skEWqgdg?t=370
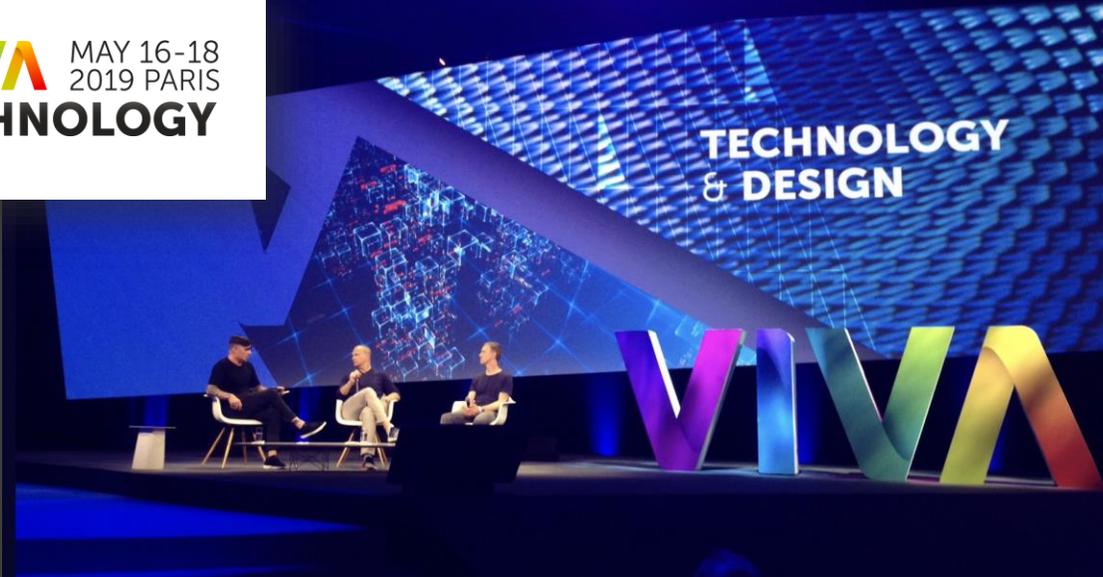
- Event of 124000 people over 3 days
- 2500 journalists
- 231 millions people of social network
- 3 billions of unique visitors on the Internet !
- The SNCF was the number one in terms of buzz

https://www.digital.sncf.com/actualites/vivatech-2019-jour-2

ARTIFICIAL INTELLIGENCE / INTELLIGENT EDGE

. EXEMPLE OF THE « MARKETING » HYPE

➔ **. WHAT IS IT ?**

. WHY ?

. HOW ?

Without Intelligent Edge

WITHOUT INTERNET

weeks

WITH INTERNET

$$$$ & energy

$$$$ & energy

$$$$ & energy

$$$$ & energy

IoT Hub

Stream analytics

Not real-time analysis !

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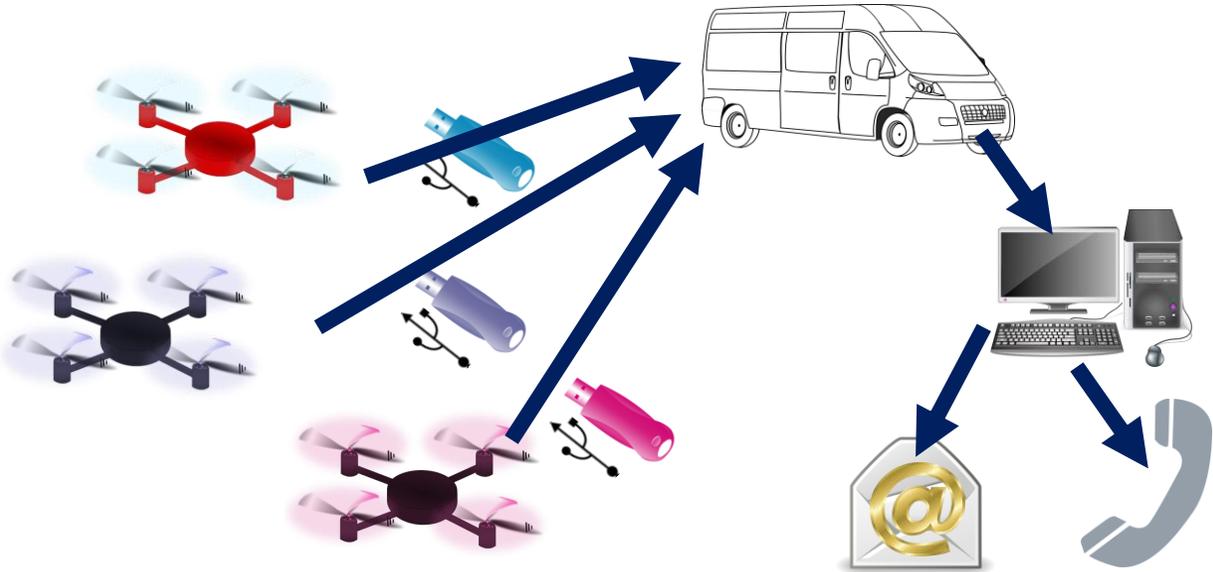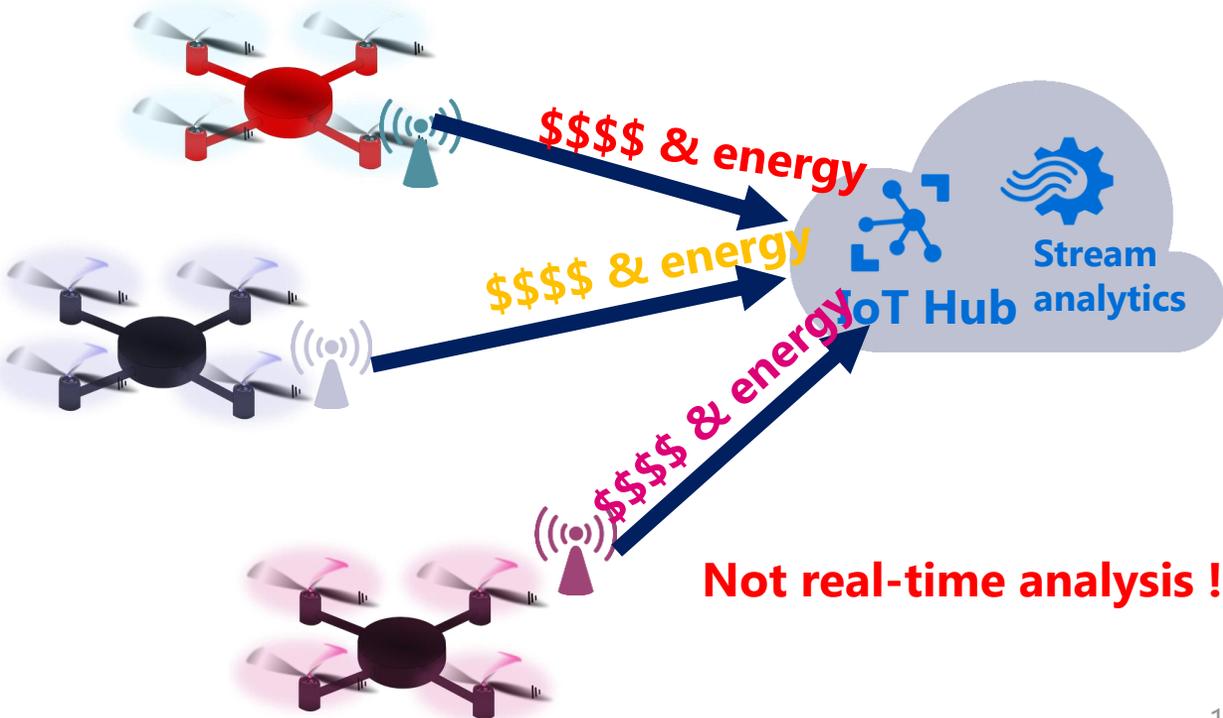
AVEC INTELLIGENT EDGE

« Simple processing » near-real-time

« Complex processing » in central
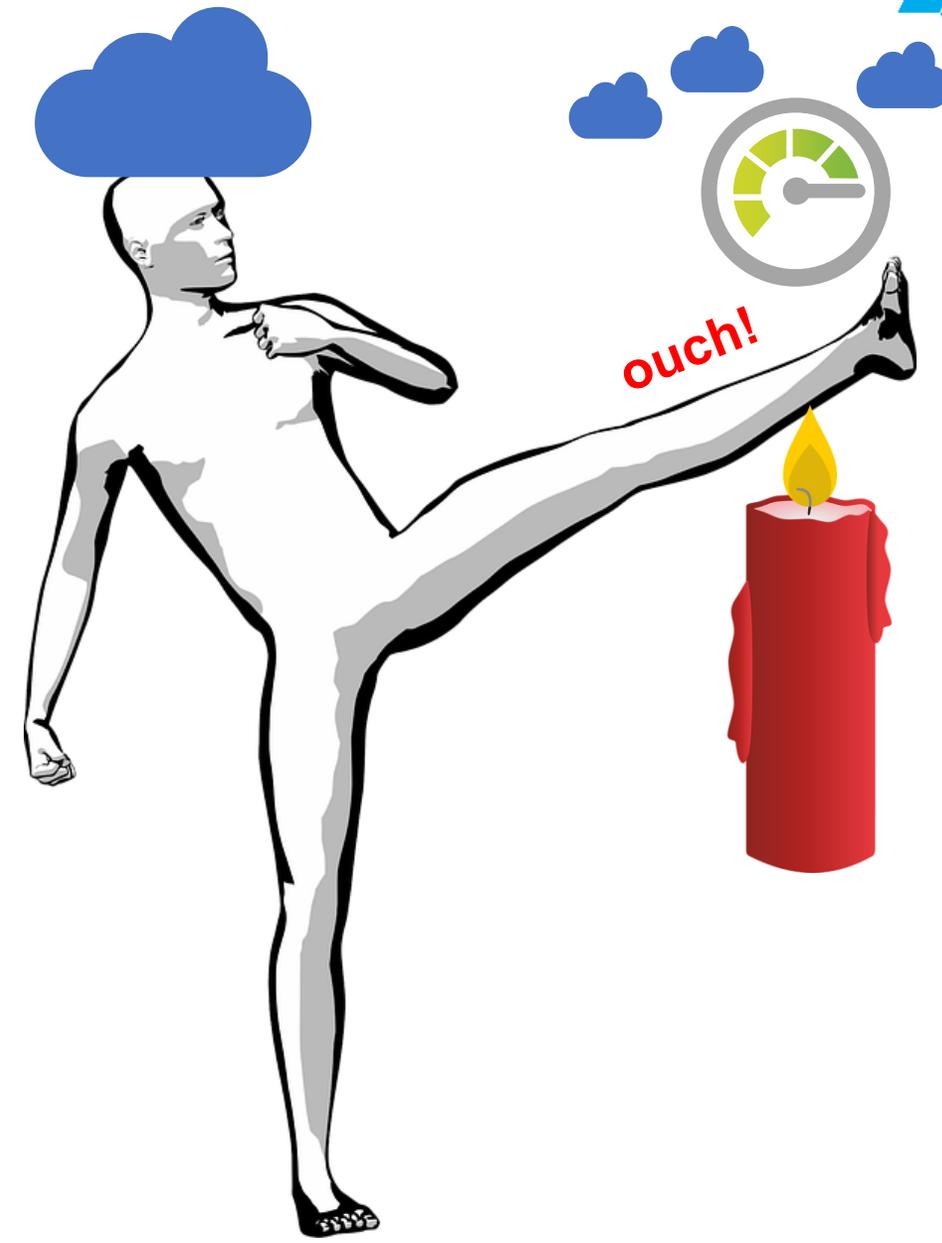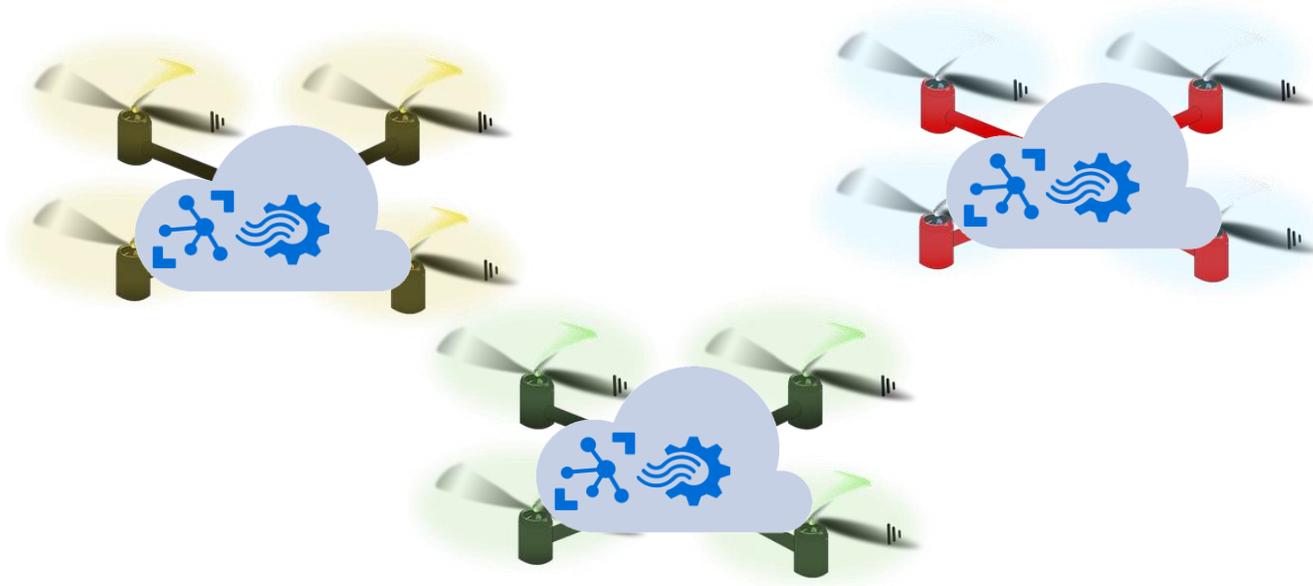
ouch!

ARTIFICIAL INTELLIGENCE / INTELLIGENT EDGE

. EXEMPLE OF THE « MARKETING » HYPE

. WHAT IS IT ?

➔ **. WHY ?**

. HOW ?

ALTAMETRIS

1. Capturing the massive data / topological

- Images, video

- Head maps

- …

2. Have a Digital Twins of the reality

- 3D-clouds of laser dots

- Infinite « zoom »

- …

3. Inspection / Detection / prediction of failiure
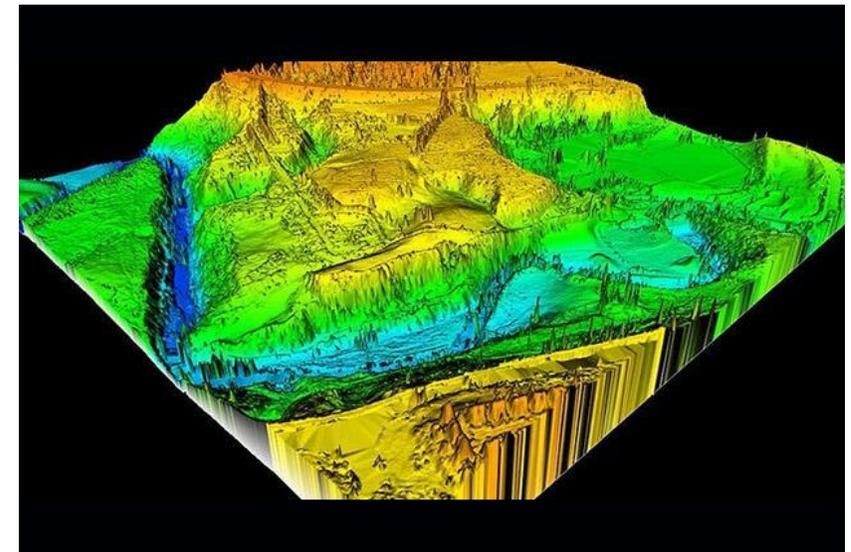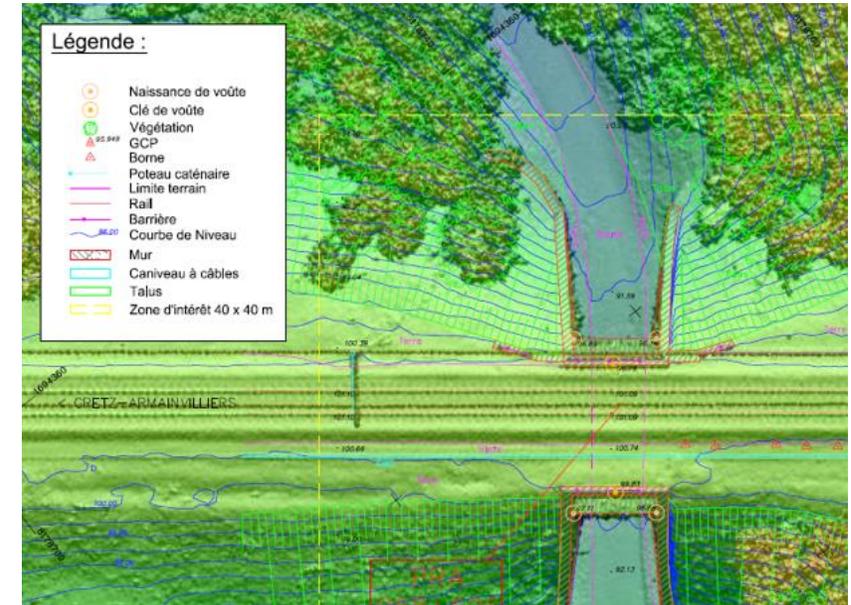
Massive projet :

- **Asset management 30 000 km (19000 Miles) railway nationwide**
- **Training VR / Maintenance ➔ "Experts à distance"**
- **½ million € drone**
IoT with trains & drones

ZOOM
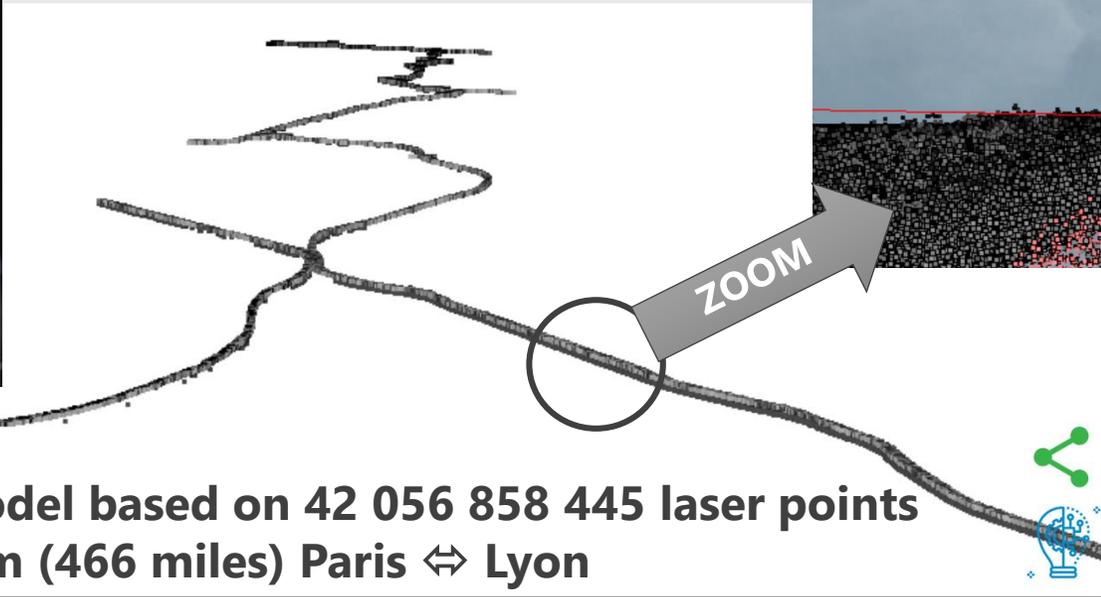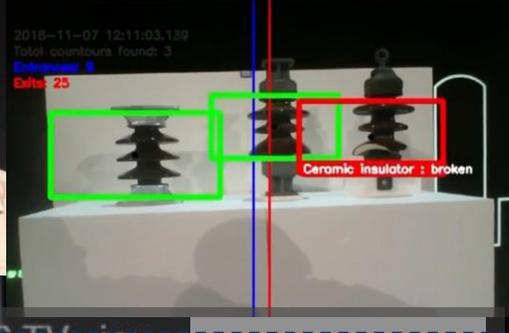
3D model based on 42 056 858 445 laser points
750 km (466 miles) Paris ⇔ Lyon

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ARTIFICIAL INTELLIGENCE / INTELLIGENT EDGE

. EXEMPLE OF THE « MARKETING » HYPE

. WHAT IS IT ?

. WHY ?

➔ **. HOW ?**

Azure

IoT Drone et R&D

Data Acquisition

DataSet annotations!

Compute (train + execute)

Modelihg

Evaluation

Cameras choices & OS & Docker... = weeks !

2 weeks over 1000 images = Trainees !

3 weeks

3 weeks Many hours of GPU

Evaluation of performance

Do it again ☹

MASSIVE DATASET

› **Thousands of images & video**

› **Combined with real insulators**

› **Labelling with rectangles**

ALGORITHM

> Weeks of reseaches
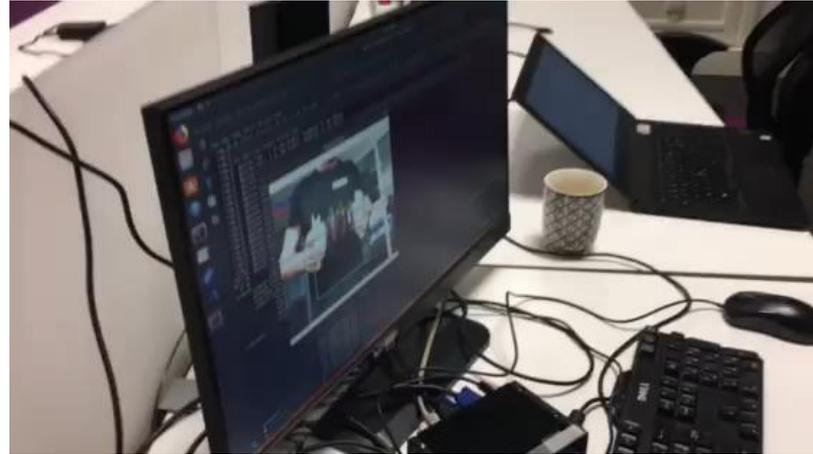
Credit Guilhem Villemin, CTO ALTAMETRIS

> Numerous iterations with ALTAMETRIS / SNCF


> Example : https://youtu.be/uC6skEWqgdg?t=370

VISEO
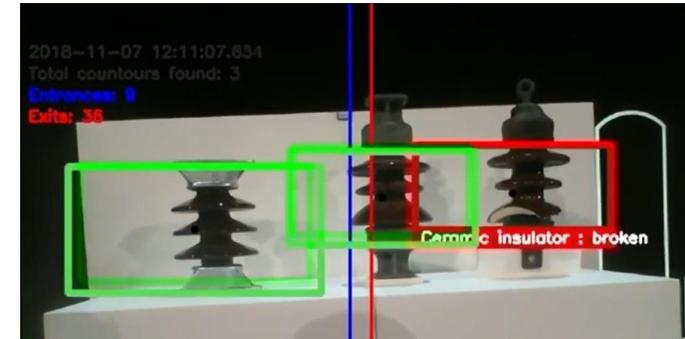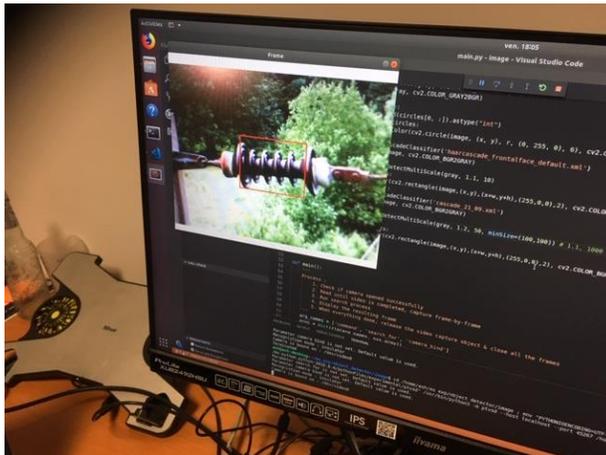
MANUAL TRANSFER TO THE DRONE VS AUTOMATED DEPLOYMENT

SOIT DIRECTEMENT de la box ADVANTECH vers le DRONE

› Either **DIRECT** copy/past from ADVANTECH box to the DRONE

› Or, via AZURE IoT Edge (& DOCKER/LINUX) via **DevOps**

VISEO

CONCLUSION

› The IoT and Intelligent Edge are a reality

› AI is the next BIG THING

› There is a robust approach, but is NO generic solution

Need « real » DataScientists with solid statistical & mathematical background AND Knowledge Expertise

› And already present in Factories for many years

In 2014 "Hannover Fair trade show", Siemens/KUKA predicted the future of the industries.

Where efficiency is seeked for many decades :
  Smart Factory : Cloud + IoT + 3D + training

QUESTIONS

HARDWARE