

# activity report 2018

The french institute of science  
and technology for transport,  
development and networks



IFSTTAR

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# editorial

## 2018: a highly productive year's work

**B**usy and productive in equal measure, for us 2018 was a year filled with good news in all areas: research, support for public policies, international actions.... despite the long wait for the legal framework for the creation of Université Gustave Eiffel, which is where our Institute's future lies. The mutual understanding seminars, which were held throughout the year with our neighbouring institutions, have already given rise to several scientific and training projects, even before the official launch of Université Gustave Eiffel. This bodes very well for the future.

In the summer of 2018, the Institute's civil engineering expertise was brought back into the limelight following the collapse of the Morandi Bridge in Genoa. When approached by the authorities and the media, our experts were responsive and provided clear and understandable explanations of complex issues. Our knowledge of transport infrastructure has also been enhanced internationally through the extensive participation of our researchers at events such as TRA 2018 in Vienna and the IABSE Congress on megastructures in Nantes. As regards public policy support, our departments worked closely with the DSR on the evaluation of the 80 km/h speed limit and with the DGITM on the Mobility Policy Bill proposed by the Minister of Transport, in particular on innovation and training issues.

Our European and international cooperation is still as healthy as ever. In addition to the creation of the Innomob Institute with the DLR (Germany) and our strengthened ties with our Japanese partners, we would like to highlight a less traditional collaboration: our participation in a T20 working group on infrastructure financing. IFSTTAR was asked to make operational proposals for one of the think tanks preparing for the June 2019 G20 meeting in Osaka.

Other good news includes a further increase in contractual research activity (which represents 77% of our own resources) and continued to produce a large scientific output that is open to society. The Sense-City Equipex has started

operations as the works for the Transpolis project are nearing completion. Some research projects have also gathered a lot of pace. This applies in particular to our work on the Fifth Generation Road (R5G), for which there is now an agreement in principle signed with CEREMA to develop a demonstrator, and FastCarb. The initial scale of this project has been tripled thanks to funding from several private companies interested in improving and accelerating the storage of the CO<sub>2</sub> in recycled concrete aggregates. It is clear that our research is of greater interest to companies and that they are more interested in recruiting young researchers and Cifre doctoral students. All these results are good reasons to be proud of our teams and the quality of their work. ●



**Hélène  
JACQUOT-GUIMBAL**

Managing Director  
of IFSTTAR

*« Our expertise  
on civil  
engineering and  
infrastructure  
in the limelight »*

# let's hear from...

## Sandrine BERNABEI CHINZI



**Sandrine  
BERNABEI CHINZI**

Director of Transport Infrastructure (DTI) at the Directorate-General for Infrastructure, Transport and the Sea (DGITM).

« IFSTTAR's expertise provides crucial support »

### —> What are the major challenges facing France in the field of transport infrastructure?

**Sandrine Bernabei Chinzi:** We have three main challenges to overcome. First, to better understand the state of our infrastructure and maintain it. While the 12,000 km of the non-concession national road network represent only about 1% of the total length of French roads, they carry more than 20% of the total traffic. This is a fact: even if we monitor and maintain our pavements and structures, they are nevertheless still deteriorating. Investments are needed to stop this process. This is why the budget allocated to the maintenance and operation of the road network was increased to 800 million euros in 2018 and the Mobility Policy Bill (Projet de loi d'orientation des mobilités) must reassert this effort to maintain and modernise our infrastructure. The second challenge is to optimise the use of existing infrastructure, in order to improve the daily mobility of the French population, particularly in urban areas. This requires traffic management measures: journey time information, dynamic speed control, ramp metering or reserved lanes (open to public transport on the A6 or A10 motorways) and we are getting ready to open dedicated car-pooling lanes. Finally, the last challenge relates to the advent of the autonomous vehicle. We have been working since 2015 on vehicles with partially automated driving. To move to a higher level of automation, we now need to implement maintenance policies and specific infrastructure improvements.

### —> How can IFSTTAR help to meet these challenges?

**S.B.C.:** The Institute is our scientific right-hand man. Its range of skills and expertise in the field of infrastructure, in particular in its MAST and COSYS departments, play a crucial role in supporting numerous collaborative and innovative research projects. Examples include MIRANDA, a low-cost pavement testing system for local authorities, SCOOP, the design of intelligent transport systems for connected vehicles, and our work with the LICIT laboratory on traffic modelling and the impact of new types of mobility on traffic. We also have significant R&D needs in the pre-operational phase, to assist infrastructure projects. IFSTTAR can also make a significant contribution on this topic.

### —> Which future issues require more extensive research?

**S.B.C.:** How can we rethink the role of infrastructure in mobility issues? How can we reduce congestion and greenhouse gas emissions? How can we address climate change? These issues raise important challenges for the coming decades, as does the topic of digital infrastructure. We have growing needs for connectivity and mapping. Here again, IFSTTAR's scientific insights will be essential to conceptualise and create "digital twins" of physical infrastructure and to foster new forms of mobility. We also need to consider measures to develop a more cross-cutting approach to mobility - in collaboration with other ministries, for example - or to support our companies and promote our technical know-how and engineering at the international level. ●



## Stephen PERKINS

« *Road use and road sharing policies must evolve* »



### Stephen PERKINS

Head of the International Transport Forum (ITF) Research Centre at the OECD and a member of IFSTTAR's Scientific Board.

#### → What role does IFSTTAR play in the ITF's activities?

**Stephen Perkins:** Working closely with the Ministry for an Ecological and Solidary Transition, IFSTTAR is a strong member of the ITF Research Committee where it helps to develop our collaborative research programmes in the area of transport policy analysis. Its researchers are regularly consulted in meetings, round tables and expert working groups with a view to producing reports and forward-looking studies, for example. The Institute is involved in improving our models and conducting more in-depth work on topical issues that are of great interest to OECD member countries: road safety, transport taxation, urban congestion control, use of large capacity heavy goods vehicles, the regulation of new mobility services (car sharing, self-service bicycles, VTCs...), etc.

#### → How does the Institute's expertise benefit your research?

**S.P.:** IFSTTAR is a world leader in several areas, such as the protection of infrastructure - particularly bridges - or the measurement and modelling of road congestion. It also has considerable expertise in assessing the environmental and economic impacts of transport policies as well as the impacts of environmental and fiscal policies on the sector, from the ecotax on heavy goods vehicles to the carbon tax. For decades, French

transport policies have been guided by the recommendations of researchers. This tradition fosters the development of long-term research that is carried out in a spirit of independence. It makes France one of the main international centres of expertise in the field of transport, along with the Scandinavian countries, the United Kingdom, Australia and the Netherlands. IFSTTAR is always ready to work with others, and is a valuable asset for the ITF. Its expertise in urban development will be further strengthened with the creation of Université Gustave Eiffel.

#### → What are your main concerns about the future of mobility?

**S.P.:** Urban road management is a crucial issue. Space is becoming increasingly scarce in cities. Transport infrastructure is

a legacy from the last century and today we need new policies for the use and sharing of roads between different users. Should we apply road pricing? What role should be assigned to electric scooters? New challenges are emerging and technology is also changing the situation, particularly with the introduction of electric vehicles, which is gradually becoming necessary due to climate change. This new propulsion system will change our habits and is already the subject of discussion on taxation as it will spell the end of fuel taxes. Another important issue for tomorrow's transport is trade, both international freight flows and passenger transport in and around metropolitan areas. These topics will be discussed at the ITF 2019 Summit in Leipzig (Germany) by more than 1,000 participants - including many ministers - who will gather together to discuss transport connectivity with a view to regional integration. ●

# highlights 2018

To find out about all the highlights

[CLICK HERE](#)

## JANUARY

### 1<sup>st</sup> January ①

Two laboratories - EMMS and SDOA - merge to create EMGCU: Testing and Modelling for Civil and Urban Engineering.

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### 9 January

The Consumer Electronics Show (CES) in Las Vegas. The ESI Group presented work resulting from a partnership with IFSTTAR's Laboratory of Ergonomics and Cognitive Sciences applied to Transport (LESCOT).

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### 26 January

1<sup>st</sup> edition of the French Mobility prizes: the Government rewarded 13 innovative mobility solutions for different areas.

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### 31 January

ITF meeting Bridge seminar. Seminar organised by the ITS working group on high-capacity vehicles.

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## FEBRUARY

### 7-8 February ②

2018 Technical Road Days (JTR): the meeting place of the infrastructure scientific and technical community, jointly organised by IFSTTAR, CEREMA and IDRRIM.

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## MARCH

### 10-11 March ③

Knowledge Summit-Inde: presentation of the INDIRA\_B (INDIcators for Reliability and Variability of Bus Systems) collaborative project during the Franco-Indian Summit.

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Identify avenues for collaboration and explore topics of mutual interest

## Mutual understanding seminars

11 meetings organised at the sites of the 6 institutions that will make up the new Université Gustave Eiffel.

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### 13 & 14 March

Trajectoires, the exhibition that examines our mobility: a two-day exhibition at Cité Descartes to explore the interactions between transport and societies at different scales.

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### 15 March

Roads: functions and contributions of Geosynthetics: A study day organised by the French Geosynthetics Committee (CFG).

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### 22-23 March ④

2018 National Masonry Days: the players involved in heritage conservation, new construction, regulations and the analysis of masonry structures came together in Marne-la-Vallée.

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### 26 March

IFSTTAR's libraries received the Collex label: IFSTTAR's documentary service received the "Collection of Excellence for Research" designation on the theme "Cities: Architecture, Civil Engineering and Urban Planning".

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## APRIL

### 3 April <sup>5</sup>

Opening of Sense-City. Philippe Tchamitchian, President of the Comue Université Paris-Est (UPE), presented the equipment of excellence for the I-SITE Future.

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### 5-6 April

SCOOP@F seminar: "Connected vehicles". Presentation of the work carried out in this pilot project for the deployment of cooperative intelligent transport systems.

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### 13 April <sup>6</sup>

IFSTTAR and Eurovia signed a framework contract for scientific collaboration on the road of the future and green growth.

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### 16 April

Transpolis: visit by Bruno Blin, CEO of Renault Trucks.

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### 16-19 April <sup>7</sup>

TRA 2018: "A Digital Era for Transport". This international conference brought together, in Austria, the main actors in transport and mobility to discuss innovations in the field.

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## MAY

### 2 May

Transpolis: visit by Anne-Marie Idrac. The High Representative for the Promotion of Autonomous Vehicles visited the innovation platform.

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### 28 May

TERRANOVA: presentation of the research operation on the recycling of new materials and the improvement of construction techniques in the fields of earthworks and construction.

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### 31 May

Ecomat LIA Seminar in Canada: the 3rd Ecomat LIA seminar brought together some 80 persons from academia, manufacturing and infrastructure management.

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## JUNE

### 1st June <sup>8</sup>

INNOMOB: IFSTTAR and the German research centre DLR signed a cooperation agreement to create the INNOMOB virtual research institute.

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### 13-14 June

Ninth National Geotechnical and Engineering Geology Days (JNGG). More than 150 oral presentations were given around the theme "Resources and facilities, what are the limits?"

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## Road riding hazardous situations for motorcycles

Jerry Serre, Christophe Perrin, Michèle Guilbot, IFSTTAR, France  
Vincent Ledoux, Cerema, France



### 18-19 June

ELECTRIC-ROAD Congress: IFSTTAR presented its hybrid solar road at this congress dedicated to innovation in the street and electric road sector.

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### 19 June

Engineering Structures 2018 Meetings: researchers showcased their work to the engineering structures community.

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### 26-28 June

French Scientific and Technical Network Transport and Travel Days. 12 workshops and National Scientific Meetings. 4 technical visits to discover the CSTB's or IFSTTAR's innovative installations: circular fatigue test track, semi-anechoic chamber...

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# Bron National Scientific Encounters

Conferences, debates and workshops on the themes:

- Can the development of digital technology make the city sustainable, social and citizen-friendly?
- The city for all
- Women and gender issues
- Climate, energy and digital technology
- Living in the digital city, etc.

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## JULY

### 5 July 9

2018 special prize awarded by the i-Lab jury.

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### 16-17 & 24 July

Participatory workshops organised by IFSTTAR and the Imagineo association with children aged 9 to 11 from the Gérard Philippe social and cultural centre in Bron (Département 69).

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### 17-19 July

CICE 2018: in Paris IFSTTAR brought together more than 300 researchers and specialists in civil engineering fibre-reinforced polymer matrix (FRP) composites.

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## AUGUST

### 14 August 10

Morandi Viaduct: our teams were approached by the media following the collapse of the Morandi viaduct in Italy.

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## SEPTEMBER

### 17 September

"Tomorrow's mobility": conference-debate on mobility in the Seine-et-Marne Département organised by IFSTTAR and Île-de-France Mobilités.

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### 17-21 September

ITS World Congress in Copenhagen: the players and stakeholders involved in intelligent transportation discovered the most recent innovations in the field of intelligent transportation systems.

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### 19-21 September

IABSE Congress: Exchanges of knowledge and practices in structural engineering during the "Tomorrow's Megastructures" Symposium.

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### 24-27 September 11

IPIN: Nantes welcomed experts in the field of indoor navigation positioning for the 9<sup>th</sup> international conference on "Indoor Positioning and Indoor Navigation".

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### 26 September

Presentation of the 1<sup>st</sup> prize-winners of the French Mobility call for projects designed to support innovations to assist daily mobility.

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## OCTOBER

### 4-14 October

Paris World Motor Show: presentation of the "5<sup>th</sup> Generation Road" (R5G) as part of the "Legendary Roads" exhibition.

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### 6-14 October

Science Festival: schools and the general public discovered IFSTTAR's activities during events and meetings held during the 27<sup>th</sup> Science Festival.

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### 8-10 October

14<sup>th</sup> Porous Media Study Days (JEMP): specialists in studying the complex behaviour of porous media gathered together at the Cité des Congrès de Nantes.

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### 9 October

FWP Atlantic Forum: after conferences and technical workshops on floating wind turbines, the 3<sup>rd</sup> edition of the forum ended in Pays de la Loire with an examination of the 1<sup>st</sup> French floating wind turbine.

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### 9-11 October

Engineering Structure Days (JOA) 2018. Annual meeting of all the "engineering structure" experts in the scientific and technical network (RST) of the Ministry for an Ecological and Solidary Transition.

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### 10 October 12

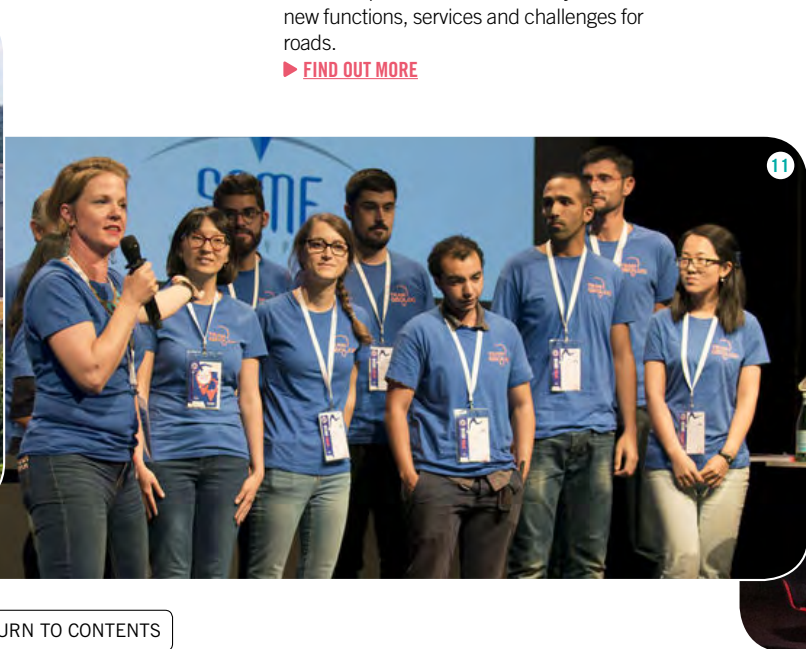
Innov'Day Rail: conferences, round tables, networking sessions. This is an opportunity to highlight the innovations that will profoundly transform future practices in the railway industry.

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### 10-11 October

IDRRIM Congress: the Institute of Roads, Streets and Infrastructure for Mobility invited the entire professional community to discuss new functions, services and challenges for roads.

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**18 October**

Seminar on “The coast and flooded zones”. Survey of areas increasingly affected by climate change, resulting in frequent dramatic flooding.  
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**23 October**

European Ambitions Day: IFSTTAR shared its experience on how to access European funds from the Horizon 2020 programme.  
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**23-24 October 13**

Franco-Japanese workshop: second Franco-Japanese meeting in the field of psychology applied to transport.  
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**NOVEMBER**

**5-7 November**

Physics of Drying Conference: Philippe Coussot from the Navier laboratory provided the framework for a review of the physical process at work in soil drying, building materials, colloids, gels, etc.  
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**8 November**

Symposium “From planners to beekeepers”: how can planners play a significant role in the protection of bees?  
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**9-15 November**

SRBT 2018: the international seminar on streets, bridges and tunnels welcomed 120 participants and 30 speakers.  
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**15-16 November**

International Forum on Sustainable Mobility. National and international mobility stakeholders - elected representatives, companies, research institutes - met up at Annemasse – Archamps Technopole and Geneva to (re)discover and (re)consider the mobility of tomorrow at both local and global levels.  
 ► [FIND OUT MORE](#)

**21-22 November 14**

FUTURE Days 2018: academics, students, firms and local authorities exchanged views on the cities of tomorrow at Cité Descartes.  
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**22 November 15**

The greening of rail transport: parliamentary commission. IFSTTAR assisted the Government in the framework of a parliamentary commission to expedite the energy transition in rail transport.  
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**26-30 November 16**

Australian Scientific Tour. Days of scientific meetings and exchanges between IFSTTAR and Monash University in Melbourne.  
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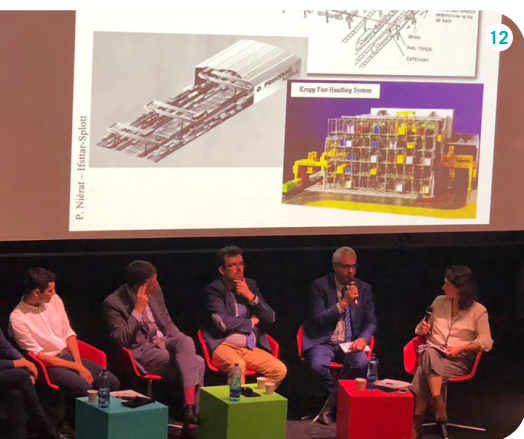


**6 December**

IMPROVMURE: presentation of the results of the ANR project “Innovation in Materials and Processes for Improving the Multi-Recycling of Mixes”.  
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**14-15 December**

2<sup>nd</sup> IFAC conference on cyberphysical and human systems. Researchers and experts from academia and industry gathered together in Miami.  
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**DECEMBER**

**4 December**

ITE unifying project seminar: involvement of international experts in order to boost the prospects for research on tomorrow's infrastructure for the energy transition.  
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**Conference cycle**

City of the Future: Sensitive urban mapping #5 #6

► [FIND OUT MORE #5](#)

► [FIND OUT MORE #6](#)

# Spotlight on...

## Road safety

### IFSTTAR, A KEY PLAYER IN EUROPEAN RESEARCH

Involved in some thirty collaborative research projects on road safety, a member of working groups on safety standards, a member of the main transport research associations... IFSTTAR is committed to furthering work and measures to improve road user safety.



The LEPSIS driving simulator.


—> On 1 July 2018, the speed limit in France on two-way single carriageway secondary roads was reduced to 80 km/h. This measure, which could save between 200 and 300 lives per year, was introduced as a result of scientific studies led by IFSTTAR, at the request of the Studies Committee at the Road Safety Delegation (DSR). The Institute is regularly consulted to guide public policies in the field of road safety. Its expertise is also recognised at European level. “We belong to three major associations of transport research institutes: FERSI (Forum of European Road Safety

Research Institutes), ECTRI (European Conference of Transport Research Institutes) and FEHRL (European Forum of National Road Research Laboratories)” affirms Dominique Mignot, Director of the Transport, Health, Safety Department (TS2). In particular, IFSTTAR is the leader or a partner in some 30 European road safety research projects. For example, LESCOT is providing its expertise in modelling driver behaviour to VI-DAS, a project that aims to improve Advanced Driver Assistance Systems (ADAS). A major European Commission transport project, SafetyCube (Safety

CaUsation, Benefits and Efficiency) involved 8 researchers from IFSTTAR and drew on the Rhône Département Register of Road Traffic Accident Casualties, a flagship road safety research tool to which the Institute contributes. The objective of this major project is: “To create an innovative decision-making support system to identify the most appropriate strategies, measures and approaches to reduce the number of casualties of all levels of severity,” explains Dominique Mignot. “We are also involved in the working groups on European safety standards\* and, internationally, in the approval of new crash-test dummies as part of the GHBMC (Global Human Body Models Consortium)”. ●

*3 priority themes:  
vulnerable persons, the injured  
and vehicle automation.*

\* For example: ISO 17488:2016 (Road vehicles -- Human performance and state in the context of automated driving -- Part 1: Common underlying concepts); ISO/TR 21974-1:2018 (Naturalistic driving studies -- Vocabulary -- Part 1: Safety critical events)



**KEY FIGURES**

- > 17 000 students
- > 500 doctoral students
- > 1 200 researchers, teaching researchers and teachers
- > 1 300 administrative and technical staff

**FUTURE** UNIVERSITÉ PARIS-EST

## Université Gustave Eiffel

# A COMMON GOAL, A SHARED APPROACH

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The new University will bring together a quarter of French research on cities and transport.

On 1 January 2020, Université Gustave Eiffel will be officially created as part of the I-Site FUTURE project. This concretises the close links that IFSTTAR has maintained with 5 educational institutions located in *Cité Descartes* for more than 20 years: the *École d'architecture de la ville et des territoires* (School of Architecture for Cities and Regions) in Marne-la-Vallée, the EIVP, ESIEE Paris, the UPEM and the ENSG. Launched in 2017, this merger was based in particular on 11 “mutual understanding seminars” held between the staff of the founding institutions. These meetings, which took the form of discussions and workshops, were held from November 2017 to April 2018, and were attended by more than 1,500 participants. They have helped to build the foundations of an institution with an original, interdisciplinary model, unique in France as well as an international calling. What new opportunities will it offer to students, researchers or teaching-researchers? How will it respond to the societal issues raised by the transformation of cities? What will be its strengths and ambitions?

The insights of representatives of IFSTTAR's 5 partner organisations are given below.

« *Providing responses that meet the expectations of cities like Paris* »

→ **Franck Jung:** As a player in the field of urban engineering, being part of this project for a University focused on the city of tomorrow with an international reach is a tremendous opportunity. Thanks to enhanced synergies between the founding institutions, our engineers will have access to new educational resources, in particular through the more frequent involvement of IFSTTAR researchers in projects or courses. The Institute is going to share its expertise with higher education.

Tomorrow, with Université Gustave Eiffel, we will be better equipped to provide analysis, technical responses and support for public policies that meet the expectations of cities like Paris. ●



**Franck  
JUNG**

Director of the *École des Ingénieurs de la Ville de Paris (EIVP)*



*construisons  
notre futur  
établissement*

**Éa  
v&t**

**Amina  
SELLALI**

Head of the *École  
d'Architecture de la Ville  
et des Territoires  
à Marne-la-Vallée*

*« Think differently  
about the growth of cities »*



—> **Amina Sellali:** Université Gustave Eiffel is an exciting opportunity for our School. We will be among the first French national schools of architecture to be incorporated into a University, and hence to benefit from a stimulating research and training dynamic as well as additional resources. It is also a challenge, because we will be able to work with new partners and conduct research in a wider range of disciplines, not only in the technical and industrial fields, but also in the fields of policy, the solidarity economy, agriculture, light mobility, etc. Our ambition is to help establish a new place for technology in a resilient and resource-efficient

world, on the one hand, but also in a world where social and financial issues remain crucial. This is the great challenge for engineers, but also everyone involved in the design of cities.

In the age of climate change, architecture has an important role to play, to meet the challenges involved in the energy retrofitting of buildings, for example, but above all to think differently about the growth of cities and see it in the long term. Université Gustave Eiffel should also enable us to participate more actively in supporting public policies, a task for which IFSTTAR has much to teach us. ●

*« A continuum that extends  
from fundamental research  
to real-world deployment »*

—> **Jean Mairesse:** This is an emblematic project that marks a turning point in the history of our School and which will shape its future. Becoming part of a body with approximately 17,000 students represents a change in scale for us and will help develop our international and research policies.

With its highly original concept, Université Gustave Eiffel has two remarkable assets: a strong geographical presence with sites and campuses throughout France, and the support of a research institute, IFSTTAR. Partnering with its researchers provides an outstanding opportunity for our teacher-researchers. The mutual understanding

seminars have demonstrated this potential for co-operation. In the field of urban sensors, for example, from research and prototyping in ESIEE Paris' clean rooms to large-scale deployment operations in Paris thanks to the EIVP, taking in experiments in Sense-City, we will be present on a continuum that extends from fundamental research to real-world deployment. ●



**Jean  
MAIRESSE**

Director of  
ESIEE Paris

**ESIEE  
PARIS**





**Gilles  
ROUSSEL**

Chancellor  
of *Université  
Paris-Est  
Marne-la-Vallée*

« *A new model  
in the landscape  
of higher education and  
research in France* »



→ **Gilles Roussel:** As a response to a pressing societal issue, the city and the transport of the future, the Université Gustave Eiffel project is an extremely stimulating challenge. This merger between a university, a research organisation and engineering and architecture schools is unique in France and entails profound transformations for UPEM. It will constitute a new model in the French landscape of higher education and research. Its smooth creation

demonstrates a genuine desire to move forward together in the same direction. IFSTTAR's sites located throughout the country, its expertise and its ability to support public policies will promote the collective production of research, training, expertise and innovation on sustainable cities, and also help to develop science that is open to society. ●

« *A set of skills  
to adapt cities  
to climate change* »

→ **Nicolas Paparoditis:** Université Gustave Eiffel is a natural extension of the historical partnerships that have linked our institutions over the last 25 years. Due to the diversity of the themes covered by its different members, it will be able to cover all the scientific and technical issues raised by the city of tomorrow. Our School currently provides part of the solution in the area, for example, of adapting cities to climate change: geomatics and geographical information systems. As part of Université Gustave Eiffel, we will have all the necessary expertise to enhance this response: SIG3D and digital information systems, digital simulation, civil engineering, sustainable transport and mobility, architecture, materials and the energy performance of buildings, the design of more energy-efficient and better integrated

infrastructure, etc. We will thus be able to collaborate on long-term projects and our students will benefit from extensive training courses to prepare them for new jobs that have yet to be invented. As a central player in our research ecosystem, IFSTTAR will be a real strength for the university, in particular thanks to its European dimension but also its experience in project management and the certification of research. ●



**Nicolas  
PAPARODITIS**

Director of the *École  
nationale des sciences  
géographiques  
(ENSG-Géomatique)*



# prizes and awards 2018

Find out about all the prizes and awards

[CLICK HERE](#)

## Prizes for PhDs

### MAST-EMGCU 1

**Thomas Guenet**

Eugène Freyssinet Award:  
Student Prize.

► [FIND OUT MORE](#)

### MAST-CPDM

**Guillaume Delannoy**

René Houpert young researcher  
award from the AUGC (University Civil  
Engineering Association).

► [FIND OUT MORE](#)

### MAST-MIT

**Illef Borghol**

3rd prize "Best doctoral student poster"  
at the JTR.

► [FIND OUT MORE](#)

### COSYS-LIVIC 2

**Laurène Claussmann**

2<sup>nd</sup> prize awarded by the  
*ThesisDay@SystemX* jury during the  
SystemX/Vedecom day.

► [FIND OUT MORE](#)

### COSYS-GRETTIA 3

**Anne-Sarah Briand**

Abertis Chair: Thesis prize 2018 in the  
transport category.

► [FIND OUT MORE](#)

### COSYS-LEOST

**Ni Zhu**

Student prize from the URSI (International  
Union of Radio Science) awarded  
during the 2018 Scientific Days of the  
French National Committee for Scientific  
Radioelectricity "Geolocation and  
navigation".

► [FIND OUT MORE](#)

### GERS-GMG

**Diego de Freitas Fagundes**

Prize for the best Brazilian thesis in the field  
of Geotechnical Engineering.

► [FIND OUT MORE](#)

## PRIZES FROM LEARNED SOCIETIES, ASSOCIATIONS AND FOUNDATIONS

### MAST 4

**François Toutlemonde**

Eugène Freyssinet Award: 2<sup>nd</sup> prize.

► [FIND OUT MORE](#)

### COSYS-LISIS

**Ratanak Din**

André Citroën Prize.

► [FIND OUT MORE](#)

### TS2-LBMC

**Sonia Duprey**

Young researcher prize awarded by the  
Society of Biomechanics (French-speaking  
community).

► [FIND OUT MORE](#)

### GERS-GMG

**Matthieu Blanc**

Jean Kérisel Prize awarded by the CFMS  
(French Committee of Soil Mechanics and  
Geotechnical Engineering).

► [FIND OUT MORE](#)

### LVMT

**Luc Charansonney**

Jean Panhard Prize awarded by the French  
Automobile Club and the Committee of  
French Motor Vehicle Manufacturers.

► [FIND OUT MORE](#)

### COSYS-LIVIC

**Mariana Netto**

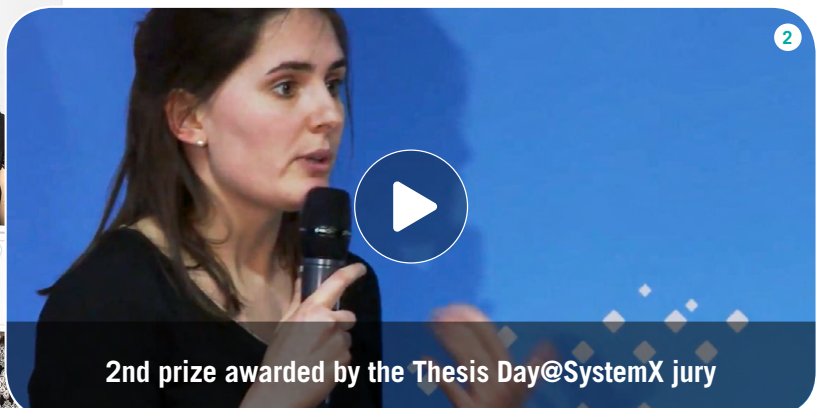
Prize for services to IFAC France.

### MAST-EMGCU

**André Orcesi**

**(with João Pedro Santos,  
Cristian Crémona and Paulo Silveira)**

Ferry Borges Prize awarded by the  
Portuguese Structural Engineering  
Association.



→ [RETURN TO CONTENTS](#)





## PRIZES FOR PUBLICATIONS / PAPERS / CONFERENCES

### COSYS-SII 5

**Vincent Le Cam, Laurent Lemarchand**

2<sup>nd</sup> Best Paper Award at the IWSHM-Railway conference in Qingdao for a paper jointly written by IFSTTAR and SNCF Recherche.

► [FIND OUT MORE](#)

### TS2-LBMC

**Marine Guinamd**

Society of Biomechanics 2018 travel award.

► [FIND OUT MORE](#)

### TS2-LBMC

**Benjamin Delpuech**

ESB travel award 2018 to take part in the World Congress of Biomechanics.

► [FIND OUT MORE](#)

### TS2-LBMC

**Martin Revel**

One of the Top 20 submissions: free registration at the World Congress of Biomechanics 2018.

► [FIND OUT MORE](#)

### TS2-LBMC

**Julia Greenfield and Mehdi Shirzadi**

Support for doctoral student mobility from the MEGA Doctoral School at Lyon University.

► [FIND OUT MORE](#)

### AME-SPLOTT 6

**Laetitia Dablanc (with Takanori Sakai, Adrien Beziat, Adeline Heitz)**

Best Paper at TRB 2018, awarded by the Urban Freight Transportation Committee.

► [FIND OUT MORE](#)

### AME

**Corinne Blanquart (with Zheng Liu, Nicolas Maudhuit, Thomas Zeroual)**

Best paper at the RIRL 2018 (*Rencontres Internationales de la Recherche en Logistique*).

► [FIND OUT MORE](#)

## OTHER AWARDS

### COSYS-LIVIC

**Olivier Orfila, Jacques Ehrlich and Dominique Gruyer**

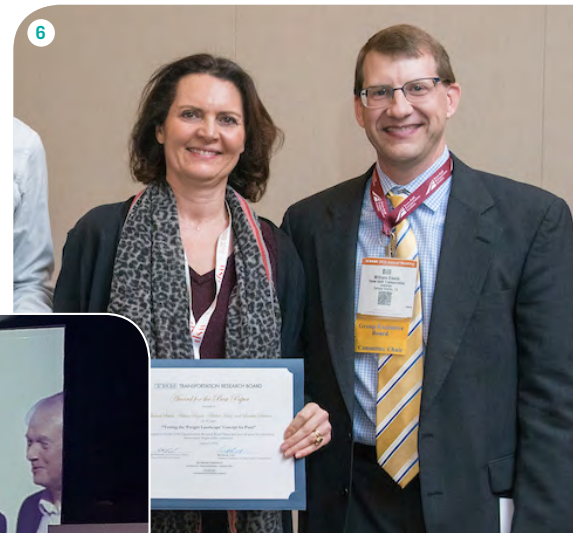
Awarded the status of "High End Foreign Expert" by China.

### Transpolis SAS 7

**Dominique Fernier**

"Man of the sector 2018" award from the FFC (French Bodywork Federation) at the bodywork sector meetings, in Lyon.

► [FIND OUT MORE](#)







# Scientific life: research and expert appraisals

Find in video the research activity of the Institute







## The Institute's scientific life is guided by the desire to respond to the major challenges facing society in terms of transport, mobility, safety, planning and the environment.

These issues were defined by the Goals and Performance Contract (COP 2017-2021) which was in its second year in 2018. The 2012 scientific strategy on mobility and infrastructure, and challenges 3 and 4 on the environment and regions are refocussed within the same theme which deals with the protection and development of regions. In addition to the three scientific themes, the 4<sup>th</sup> theme aims to encourage and promote scientific excellence and technology transfer within the institute. The scientific results that stem from these four themes in 2018 are presented in part two of this activity report. ●

**Serge PIPERNO**, *scientific director*  
**Antoine FRÉMONT**, *assistant scientific director*



THEME 1



VIDEO

### EFFICIENT TRANSPORT AND SAFE TRAVEL

#### GOAL 1

Improving the reliability of passenger and freight transport for all modes and purposes, with well-managed costs and externalities

#### GOAL 2

Enhancing the safety and ergonomics of transport, for mobility that is stress-free and respectful of human

#### GOAL 3

Making progress with regard to multimodal, intelligent, clean and seamless systems and services



THEME 2



VIDEO

### MORE RESILIENT AND EFFICIENT INFRASTRUCTURE

#### GOAL 4

Modifying infrastructure, at the lowest possible cost, in response to climate change and new operating and maintenance requirements

#### GOAL 5

Helping to build a circular construction economy by increasing the use of renewable materials and alternative biomaterials

#### GOAL 6

Developing new generations of transport and energy production infrastructure that take account of the digital transition



THEME 3



VIDEO

### PLANNING AND PROTECTING REGIONS

#### GOAL 7

Foreseeing natural and climate risks in order to improve the resilience of cities and regions, reduce their vulnerability and protect the population

#### GOAL 8

Understanding, evaluating and streamlining the interactions between infrastructure, transport services and planning policies, as well as their impacts on the environment and the population

#### GOAL 9

Helping to implement sustainable regional planning, especially in urban areas



THEME 4

### FOSTERING AND PROMOTING SCIENTIFIC EXCELLENCE AND TECHNOLOGY TRANSFER

#### GOAL 10

Creating conditions that foster excellence in research

#### GOAL 11

Sharing scientific and technical output, knowledge and know-how

#### GOAL 12

Increasing the Institute's contributions to innovation

# RESEARCH FOR THE BENEFIT OF PUBLIC POLICY AND SOCIETY

## Our scientific priorities

Cold logistics for pavement replacement, mooring cables for offshore wind turbines, autonomous vehicles as well as road safety, methods for observing and measuring urban mobility or logistics: these are all examples that demonstrate how IFSTTAR researchers are addressing major societal challenges. The issues raised require preliminary and applied research but also expert assessments, all three of which advantageously feed into one another.

Rooted in the skills of its research teams and laboratories, IFSTTAR conducts research in

the fields of mobility, safety, planning and the environment. In 2016, the institution carried out work to focus its activities on “priority themes”, that are central public policy challenges in these areas as well as on themes where its impact is strong and eagerly awaited. This strategy, which is explained in greater detail than the “10-year scientific strategy” defined in 2012, is the basis for the Institute’s current research, which in turn is beginning to partially shape the future scientific strategy of the planned University. ●

## Informing public policies

Before the requisite decisions are taken, the formulation of public policies must be founded on an exploration of the full spectrum of possibilities. IFSTTAR is doing its utmost to do this both at the national level in conjunction with its ministerial supervisory bodies (MTES, MESRI and DSR) and at the local level with local authorities. This support can take several forms, sometimes even including a framework contract such as that signed in 2018 with the STAC or a letter of intent such as that presented in September 2018, in collaboration with CEREMA and the Ecole des Ponts Paristech, with the Seine-et-Marne Department on the theme of the road of the future. IFSTTAR assists the DGITM on the theme of the Automated Vehicle by participating in the working groups that are managed by the Ministry.

The Institute assisted the parliamentary commission led by the Deputy Benoît Simian on the **greening of rail transport** as co-rapporteur with the General Council for the Environment and Sustainable Development and the General Council for the Economy. The commission paves the way for the trialling of hydrogen powered regional trains by 2022 in conjunction with the Regions. This trial could subsequently lead to a wider deployment of this technology if its potential is confirmed. IFSTTAR organises several technical days with CEREMA. These cover **roads, engineering**

**structures, masonry, acoustics and vibrations** and **geotechnical engineering**. These days make it possible to transfer research outcomes to an entire community and promote the production of technical guidelines. ●

## The involvement of the five departments in supporting public policies

In 2018, IFSTTAR’s five departments were involved in a wide variety of public policy support missions.

For AME, there have been many requests: the mobility consultation and the preparation of the **Mobility Policy Act**, which led to the production of reports on carpooling, the governance of mobility, the improvement of air quality and data management. More specifically, researchers from the department were interviewed by the Deputy Damien Pichereau with regard to Light Commercial Vehicles, met the Supreme Audit Institution on the subject of low-carbon road transport, produced a report on the external effects of transport with the think-tank TDIE, and participated in **round tables organised by the International Transport Forum** (ITF-OECD) on the value of time and the resilience of supply chains.

Élisabeth Borne with I. Fauchoux on the left and B. Simian, A. Frémont, H. de Tréglodé on the right





The Proteus project water circuit © Ifsttar-Merliot



Morandi viaduct © Wikimedia commons / Michèle Ferraris

As part of the **European PROTEUS project**, COSYS researchers have developed a low-cost nano-sensor to measure water quality in networks. It has been tested in a Portuguese city (Almada) and will shortly be deployed in India.

In the framework of the **Matriochkas project** conducted with ONEMA and the Loire Bretagne Water Agency, GERS has made recommendations to local authorities with regard to remedial measures for urban areas (retention basins, green roofs, roadside ditches) in order to reduce peak flow and pollutant transfer after heavy precipitation. The **seminar on the coast** organised at the Maison de la Bretagne in Paris brought together employees of the MTES (central services and the Regional Directorate for the Environment, Planning and Housing (DREAL)), as well as researchers and planners from different institutions to discuss the complex issue of the coast.

MAST was much called upon to provide its expertise in the field of engineering structures after the **Morandi viaduct disaster**. IFSTTAR's reactivity in the summer period was praised. In addition, the department puts its expertise on the service life of structures at the disposal of the public authorities.

#### ► FIND OUT MORE

Newspaper /

**Morandi Viaduct: IFSTTAR at the microphone of journalists**

TS2 remains very strongly involved in road safety issues: road safety for school pupils of the Auvergne-Rhône-Alpes Region, an appraisal of the 80 km/h speed limit for the Road Safety Directorate (DSR), and an assessment of the geographical and/or thematic extension of the **Rhône Road Trauma Register**. In addition, in the framework of the **Committee of experts and ANSES**, several reports have drawn attention: "**health risks related to wind turbines**", "**hypersensitivity to electromagnetic fields**", "**health risks to children of electromagnetic waves**". A partnership with the French Public Health Authority on the subject of domestic accidents was set up based on the use of data from the **ORAT** (Rhône-Alpes Trauma Monitoring Centre) and a study that deals with head injuries. ●

## RESEARCH CONDUCTED IN SYNERGY WITH OUR INTERNATIONAL PARTNERS

IFSTTAR maintains an extensive network of international and European partnerships. 2018's activities were concentrated in two complementary areas: organising partnerships and putting research and training on an international footing.

As far as setting up partnerships is concerned, IFSTTAR has formalised its active collaboration with the DLR in Germany by creating a Franco-German Institute known as **InnoMob** (Innovation for Mobility) by means of an official agreement signed in Berlin on 1 June 2018. This institute now has the same scope as the AME department and will facilitate mobility between the two bodies, the co-supervision of doctoral students, research projects and responses to European calls for projects. In Asia, in 2018 IFSTTAR strengthened its ties with its Japanese partners (PWRI - Public Works Research Institute, PARI - Port and Airport Research Institute, RTRI - Railway Technical Research Institute, University of Tokyo) by organising a visit by a delegation of researchers from several IFSTTAR departments on the following topics: geotechnical engineering, safety assessment and structural condition monitoring, material recycling and BIM for civil engineering.

► FIND OUT MORE



The participants in the Franco-Japanese Workshop

With regard to the internationalisation of research and training, IFSTTAR was involved in organising an **ETNA 2020** project event at the **TRA 2018** conference in Vienna. This workshop on international cooperation in the framework of the H2020 programme (Focus on **INCO Flagships**) included among its speakers a member of the European Commission (DG Research & Innovation), several



ETNA 2020 Workshop at the TRA 2018 conference in Vienna



National Transport Contact Points and a European project coordinator who presented a “success story”. It brought together about forty participants.

In addition, in line with the cooperation agreement signed between France and Sweden, IFSTTAR, in association with other future members of Université Gustave Eiffel, participated in meetings with Swedish universities and research organisations



Signing of the agreement with the DLR

to define areas for the development of European training on topics related to sustainable urban mobility and up and coming research themes. These meetings resulted in a Franco-Swedish

seminar to be held at ESIEE Paris on 11 and 12 June 2019 (on the theme “Smart cities and mobility”) as well as a project for a joint Master’s degree on security issues. ●

# RESEARCH THAT IS OPEN TO SOCIETY

Because its function is to serve society, IFSTTAR’s research must be made accessible so it can be disseminated and transmitted to all our fellow citizens.

## Open access and research data

IFSTTAR promotes open science by taking measures that address the two main areas defined by the **national open science plan**: open access to research publications and data.

IFSTTAR is thus pursuing its policy of open access distribution of its researchers’ publications. It implements the provisions of Article 30 of the Digital Law allowing the “postprint” version of articles to be deposited in an open access archive. In 2018, the percentage of articles published in international peer-reviewed journals the year before with open access availability in the “**Madis**” institutional archive had risen to 56% compared to 34% in 2016. To achieve such a result, an open access culture must be fostered among researchers, which requires targeted

communication activities, in particular an **Open Access Week**. In addition, 2018 was the first year of IFSTTAR’s membership of **DOAJ**, the Directory of Open Access Journals.

Opening up research data also means that researchers must be supported. Standards and requirements for the management and openness of research data are increasing in number and are impacting research laboratories. In order to inform them about these developments, a **data management policy** has been put in place and disseminated within the institute via a dedicated intranet area. As far as “dissemination” is concerned, this policy outlines the situations in which research data can be disseminated as open data and the best practices for making it easy to



find, accessible, interoperable and reusable by the scientific community and citizens. An **open access institutional data warehouse** and **support** are available to researchers to help them in their open access project. Above and beyond data openness, researchers can also be supported through all stages of the data lifecycle: collection, storage, archiving, as well as the planning of data management both upfront and throughout their project. ●

\* The version that exists after the authors have taken account of the comments of the reviewers and the paper has been accepted by the editorial committee.





Transport, Mobility and Security: a matter of gender? » © Joël Yerpez

## An editorial policy in favour of digital technology and open access

In line with its commitment to Open Science, since 1 January 2018, IFSTTAR has published the **journal RTS** (Recherche Transport Sécurité) exclusively in digital format and with open access on the HAL open archive. All the articles that have appeared in RTS since 2013 are also available in the collection **HAL Recherche Transports Sécurité**. For **IFSTTAR's collections**, the open access publication of books under the Creative Commons licence has become a standard that has been fully embraced by their authors, coordinators and readers. In 2018, the following titles were added to the collection:

- **SaPPART Guidelines: Performance assessment of positioning terminals**
- **Actes des 9es Journées Nationales de Géotechnique et de Géologie de l'Ingénieur**
- **Recommendations for preventing disorders due to delayed ettringite formation**
- **Optimisation de formes en sciences de l'ingénieur: Méthodes et applications**
- **Le béton recyclé** ●

► [FIND OUT MORE](#)

## Science for and with society

To facilitate the dialogue between science and society, a training course on the popularisation of science entitled "Adapting your scientific discourse to all audiences" has been available for the past two years to the Institute's scientific and technical staff. Twenty-seven researchers, doctoral students and technicians have received this training.

In order to share its scientific and technical knowledge, **IFSTTAR's "Science Topics" collection** has gained its 9<sup>th</sup> file, entitled **Transport, Mobility and Security: a matter of gender?** and another file **Can concrete be green?** has been updated. The science and society web space has acquired a new publication format, "**Focus on**", which consists of short articles on the latest scientific developments intended for the general public.

To reach younger audiences, stimulate their interest in science and foster their critical thinking, IFSTTAR has organised participatory workshops with the **Gérard Philippe social and cultural centre** in Bron and the **association Imagineo**. This gave an opportunity for about fifty children to share their innovative, insightful ideas. This is a source of inspiration for researchers that is to be discovered on the web documentary "**The street shared by all its users – Children's voices**".

The web-documentary, an interactive narrative tool that exploits several media, is one of the institute's

new multimedia dissemination formats: see also "**Heading for adventure with the autonomous vehicle**".

Among the year's most significant audio-visual productions was the video on the I-Site BioAdd exploratory project, entitled "**Biomimicry and additive construction: What can we learn from bees?**" and a series of interviews conducted in the framework of the "**Future-oriented workshop on automated mobility**" which deals with the societal impact of the deployment of the autonomous vehicle. ●

The "Future-oriented workshop on automated mobility" - Interviews

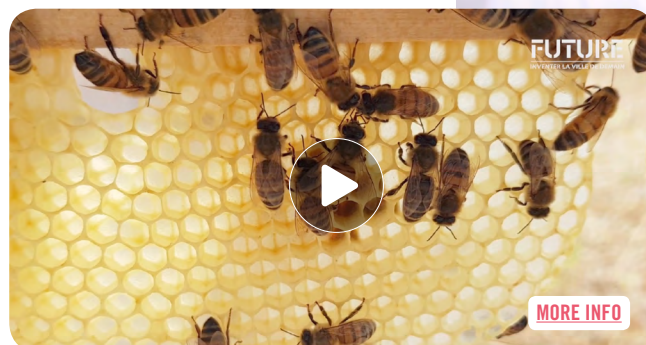


GUILLAUME USTER  
Chargé de recherche ESTAS  
Évaluation des Systèmes de Transport Automatisés et de leur Sécurité  
IFSTTAR

Web documentary "The street shared by all its users – Children's voices"



[MORE INFO](#)



[MORE INFO](#)

BioAdd Project:  
«Biomimicry and additive construction: What can we learn from bees?»

## Giving research a central place in current events and in the regions

As part of the **Bron national scientific encounters** (RSNB), two rounds of public meetings were held for a total of five annual conferences on the themes “Can the development of digital technology make the city sustainable, socially inclusive and citizen-friendly?” and “The city for all”.

The cultural, scientific and geographical “City of the Future” project gained momentum in 2018. The series of lectures on “sensitive urban mapping”, continued at the Maison de la poésie de la ville de Paris with two lectures. In February 2018, the evening event “**Maps and graphics of migration: reinventing representations**” was an event attended by a lecturer in architecture, a researcher in social geography, a writer and a choreographer.

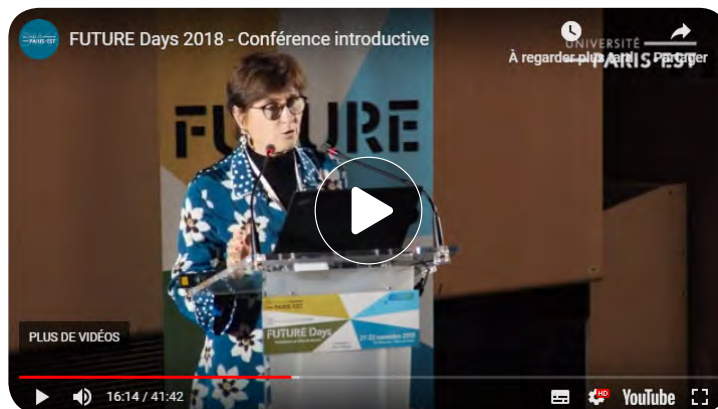
In partnership with the University of Paris-Est, IFSTTAR and the Town Council of Champs-sur-Marne organised, as part of the “**Future Days**” in November 2018, a science and society meeting on the theme “Living in a digital world? Opportunities and challenges for the area and its inhabitants”.



On the left: Bernard Blanc, Managing Director of Aquitains, the Social Housing Authority for the Metropolis of Bordeaux and Managing Director of Coopair(s), in the centre: Olivier Frérot, Engineer, Urban Planner, Philosopher, and the founder of Philométis

Launched by IFSTTAR and the Île-de-France-Region through Arcadi, the “Future-oriented Ideas Laboratory” (Laboratoire d’Idées Prospectif” (LIP)) has brought together actors from the Descartes Campus and cultural players from Île-de-France to discuss the issue of the “cultural

places of tomorrow”. During the academic year 2017-2018, five participatory nomad workshops were held in innovative cultural spaces and led to the development of scenarios for 2040, which can be accessed on the blog <http://lip.coopeco.co>.



Cécile Delolme, Vice President I-SITE University Paris-Est during the FUTURE Days 2018

## Research ethics and scientific integrity

Supporting public policies such as opening up research to society requires the guarantee that research is ethical with regard to complex issues such as the digital transition or the emergence of the autonomous vehicle, and that the scientific integrity of the research conducted is ensured. To help achieve this, IFSTTAR has had a joint Ethics Committee with IRSTEA since 2015. The Institute has signed the **national code of ethics for research activities** (2015) as well as that on openness to

society. In 2018, the work of the Ethics Committee focused in particular on scientific integrity. On the basis of the recommendations of the Ethics Committee, IFSTTAR is seeking to put in place a scientific integrity policy based on the principle of “Prevent, warn, assist”. Prevention and warning above all require information and awareness through the Institution’s various bodies in order to involve all staff, first and foremost researchers. An Intranet page is also dedicated to scientific integrity. In 2018, a scientific integrity advisor was appointed, who also performs the same function for the UPEM.



# NEW ASPIRATIONS WITH THE FUTURE UNIVERSITÉ GUSTAVE EIFFEL

With the I-Site FUTURE and the scheduled creation of Université Gustave Eiffel on January 1, 2020, new research and training opportunities are opening up.

## Implementing of the I-Site Future project's initiatives

After the mutual understanding seminars conducted until mid-2018, the time has come for the practical implementation of the I-Site project. IFSTTAR is strongly committed to implementing the many scientific initiatives of the I-Site FUTURE project and to considering the future scientific leadership of Université Gustave Eiffel.

The I-Site project includes a number of initiatives. In terms of research, 2018 was a crucial year. Indeed, the calls issued in 2017 generated a very great number of responses, with the participation of more than 300 researchers from various institutions. The international evaluation and selection process conducted by the I-Site Advisory Board was completed, with the selection of four "**Springboard**" projects, which are the most ambitious, and five "**Impetus**" projects. IFSTTAR's teams are closely involved in the selected projects. A dozen small one-year "**Exploratory**" projects were also selected. All these projects got under way in 2018. A new call for projects, for all three types, was launched in 2018 and the responses received are now being evaluated. This second call was marked by a shift towards the "Humanities and the Human and Social Sciences", which were under-represented in the responses received in 2018 for the Impetus projects. Finally, the end of 2018 saw the launch of a "Call for Visiting Professors" in early 2019, which adopts an innovative format aimed at building long-lasting international partnerships. ●



## Organising research and public policy support in the future University

At the institutional level, the I-Site project includes the creation of a new National University, whose entire organisation is to be constructed. As far as research is concerned, the model of the future organisation has been the subject of intensive studies, started in the mutual understanding seminars, continued in two multi-institutional working groups and discussed during three meetings of the future University's research units. While the basic building blocks of the new University's research are its research units, the models governing their coordination and management still need to be linked up. The objective, as when IFSTTAR was

created, is to bring together different customs and cultures and to build cross-disciplinary and ties, in order to achieve a merger that goes beyond existing interactions, without weighing down the organisation or doubling our major management tools ("Springboard" projects, **LabEx** from the PIA, research groups, etc.).

The future University will continue to support research-related public policies. During the **mutual understanding seminars**, several workshops addressed this issue and discussed the need to organise this collective activity within the new institution. A working group will be launched in 2019 on the subject. ●

## Attractiveness at the International and European levels

European and International strategy now takes account of the enlarged ambit of Université Gustave Eiffel, which should make it possible to increase IFSTTAR's influence and attractiveness, to co-construct the **European Research Area** and to help to build European and international meta-structures. IFSTTAR has started to share documentary resources with the Université Gustave Eiffel partners via dedicated seminars. It

has also proposed the first Info Days at the Marne-la-Vallée site as part of the Université Paris-Est Community in order to encourage the filing of projects within the framework of Horizon 2020, in particular for ITN (Innovative Training Networks) and ERC calls. IFSTTAR has also initiated projects related to international training (summer school, France-Sweden workshop, etc.), ERASMUS+ building capacity projects. ●



## Adding economic value: the “La Vallée” eco-district: the first example of stronger cooperative links with the world of business

In 2018, work is continuing in order to organise a major demonstration programme on the site where trials are to take place, namely the “**La Vallée**” eco-district: Covering an area of 20.6 hectares, it is located in Châtenay-Malabry on the site of the former Ecole Centrale de Paris and bordering on the Parc de Sceaux. This project is being conducted jointly by the EIFFAGE group and the partner institutions of the I-Site FUTURE that have signed the framework agreement that has been in effect since May 2018. With €2 million of funding, provided by EIFFAGE and the I-Site in equal proportions, this project, known as “E3S”, aims to help design an innovative Eco-district that is more “Economical”, “Smarter” and more “Secure”, thus meeting

the three challenges laid down for the I-Site FUTURE project based on innovations that will be implemented as the project progresses. Eight workshops bringing together researchers and EIFFAGE staff are to be held in order to specify and implement the innovations. They will cover the following topics:

- Better communication between project stakeholders, future occupants and local residents,
- A way of measuring residents' well-being,
- Innovative water management (collection and re-use, mitigating urban heat islands),
- An example of a circular economy through the reuse of deconstruction concrete and the management of bio-waste,
- Optimisation of worksites to limit their impact

on local residents and facilitate the work of construction teams,

- New mobility services,
- A roadway with increased functionalities (light ambiance),
- Innovative use of urban data in the design or management phase.

Bringing together 26 laboratories of the I-Site FUTURE, this project demonstrates the value for a business partner such as the EIFFAGE group (integrating all its components: Sustainable Development, Planning, Roads, Energy/ Services, etc.) for the creation of a research structure that can take advantage of the opportunities to expand its research and innovation capacities. ●



# PURSUING AN ACTIVE POLICY OF LEADERSHIP, ORGANISATION AND SCIENTIFIC RECOGNITION

Looking ahead in this way towards the new establishment in no way prevents IFSTTAR from pursuing an energetic scientific policy.

## Cross-disciplinarity and research leadership

Cross-disciplinary scientific leadership aims to manage and monitor themes defined in the **Goals and Performance Contract (COP)** that cut across the departments. It consists of proposing new issues on which IFSTTAR's contribution is awaited, encouraging the teams to work together when setting up projects, whether contract-based or internal, and proposing new approaches or instruments for research governance.

At the level of the Institute it provides a real driving force for improving scientific coherence between the various commitments that have been entered into (scientific strategy, goals and performance contract, the scientific projects of the departments, etc.) and the work carried out by the researchers. Cross-disciplinary scientific leadership also allows questions to be asked about the relevance of ongoing research work to developments in the

international, European, national and regional contexts. It complements the leadership activities of the departments, which are organised according to their topics of study or disciplines.

The two examples of the "**Future-oriented workshop on automated mobility**" and the **National Mobility Consultation** show the importance of this coordination work. The skills of the five departments are called upon to address complex technical and societal issues that require interdisciplinary dialogue between the engineering sciences, life sciences and the social and human sciences.

The **unifying projects** actively participate in this cross-disciplinary scientific coordination by helping to respond to the most recent concerns expressed by the Ministries responsible for its technical supervision, particularly those relating to the environmental, energy and digital transitions.

These are four major projects launched in 2017:

- **Ville 2050**, towards a sustainable ecosystem;
- **Mobility and digital transitions**;
- Infrastructure for the energy transition;
- Virtual traveller: Simulate humans in their environment to foresee the impacts of tomorrow's mobility.

They make it possible to set up a community of researchers who can respond to the I-Site Future calls for projects while also drawing in I-Site partners on the theme covered by the unifying project, supporting master's thesis internships, proposing topics for PhD's and organising internal and external partnerships through seminars to which French and foreign scientific figures are invited.

The transfer seminars enable IFSTTAR to consolidate its role of promoting research and supporting public policy, in line with the objectives of the COP. They strengthen IFSTTAR's key relationships with the State and its public sector partners. Jointly devised by the DRI at MTES, the DGRI at MESRI and IFSTTAR, they provide a link between the users of research and researchers. Public policies thus benefit from advances in knowledge from research and IFSTTAR's assessment capabilities, while research benefits from a context in which to conduct research and sources of inquiry.

Seven seminars were held in 2017 and five in 2018. The topics were as follows: rail safety, data for road safety, **autonomous mobility**, new testing and monitoring methods, eco-materials, infrastructure and the energy transition, **the coast and flooded zones**, and lastly pollutants. Feedback on these seminars is already very positive. ●

The 4 unifying projects of Ifsttar



## Support for doctoral students

Since its creation in 2011 and until the end of 2018, IFSTTAR has trained 642 PhDs. Their employment rate (both fixed-term and permanent contracts) after one year is 90% for students who earned their doctorate in 2017, for the third year running. It is higher than 93% for those who gained their PhD in previous years. The overall response rate to the survey is 97%, which is much higher than for national surveys.

191 “IFSTTAR” doctoral students are currently working at IFSTTAR or in its jointly-managed research units. While they are working on their thesis they are the subject of continual attentive monitoring, in a way that has been formalized since 2013 as part of a quality process. 19 other students are waiting to defend their thesis.

Thesis funding is becoming more and more diversified, and calls for considerable foresight on the part of all researchers and constant adaptation on the part of IFSTTAR's various departments. Seventy-one (37%) of the doctoral students have subsidised contracts with IFSTTAR, sometimes with co-financing from the Regions (Pays-de-la-Loire, Hauts-de-France, Bourgogne-Franche-Comté, Provence-Alpes-Côte d'Azur), another organisation (CEREMA) or research contracts. Nine doctoral students (5%) are co-financed by IFSTTAR, through an 18-month fixed-term contract. The other sources of jointly-financing consist of another organisation (Adème, Météo France...), or a foreign university for co-supervised research (Canada, China). Research on 30 theses (16%) with a CIFRE contract is currently



642 thesis defenses since the creation of IFSTTAR

ongoing, 21 of which have an IFSTTAR accompanying contract. Twenty theses (10%) are fully funded by a research contract. Sixty-one (32%) receive funding from various sources (ITPE4A, IPEF, IFSTTAR, doctoral or fixed-term contracts from other organisations or universities, IRTs and ITes...).

In 2018, IFSTTAR awarded 23 doctoral contracts, representing a financial commitment of €2.3 million. In addition, 11 doctoral contracts were signed with an external employer. Work on 11 CIFRE theses, 5 theses with a research contract, 7 theses with fixed-term contracts (including 2 theses that are co-supervised with Canada and China) and 3 ITPE4A theses have commenced. In all, work on 63 PhDs was started in the Institute's laboratories or jointly-managed research units. At the end of the process, 67 theses were defended in 2018. ●

► [FIND OUT MORE](#)

## Changing research structures

IFSTTAR's research structures are evolving in order to adapt not only to local contexts but also to changing themes and staff. In 2018, the two “structures” laboratories that are part of the MAST department, SDOA and EMMS, merged to create the “Testing and Modelling for Civil and Urban Engineering” laboratory **EMGCU**, within the MAST department. An embryonic team in New Aquitaine

**ERENA** (COSYS department), a joint research team that brings together Agro Campus Ouest via its EPHOR unit and the Water and Environment Laboratory of the GERS department. Several other projects for joint teams are in the pipeline. ●

► [FIND OUT MORE](#)

## Paving the way for HCERES' evaluation of our departments

2019 is a pivotal year in the construction of the future establishment. It is based on the preparation in 2018 of the HCERES evaluation of its departments (and the **Environmental Acoustics Unit** it manages jointly with CEREMA). The Scientific Directorate has been supporting this preparation and coordinating the support given by the other operational directorates to the departments, in particular for the development of indicators and documents outlining IFSTTAR's policies in the areas of quality, health and safety, as well as information systems. These items were added to the files. The evaluations, the visits for which will take place in 2019 and lead to detailed reports, will be used to build IFSTTAR's self-evaluation file and then the project for the future establishment. ●



# FACILITATING NETWORKING, PROJECT DEVELOPMENT AND THE MONITORING OF RESEARCH

IFSTTAR is continuing its efforts to assist its research units and researchers in their day-to-day research activities.

## Framework contracts and collaborative networks

IFSTTAR strengthens its network and partnerships through alliances or framework contracts with other institutions. At the national level, 2018 was marked by the signing in March of a **scientific cooperation agreement** on the theme “Cities and Transport” with Compiègne University of Technology.

IFSTTAR has also formally implemented the charter of good practices for academic and institutional partnerships that was adopted at the end of 2017, as a result of the drafting of a procedure for setting up, leading and monitoring academic and institutional partnerships.

IFSTTAR also actively participates in the life of the Université Paris-Est Community at each of its sites, as well as in the work of the National Research Alliances. As an associate member of Ancre, IFSTTAR contributed in particular to a study

by the Consortium de Valorisation Thématique coordinated by IFPEN, which was released on December 18, 2018, on the **challenges involved in developing new engines for off-road vehicles**. Within the Allenvi Alliance, IFSTTAR participated in the strategic review of new formats for Thematic Groups and the future “Major Cross-Cutting Issues”.

IFSTTAR maintains many institutional relationships through its many Jointly-managed Research Units (UMR) and joint research teams. In 2018, the project to set up a UMR with Université Paris 5, which included the Mobility and Behaviour Psychology Laboratory and the **LaPEA** - the Laboratory of Psychology and Applied Ergonomics - was evaluated by HCERES and the principle was adopted by the Scientific Board. It will be the institution's 10<sup>th</sup> UMR. ●

## Supporting the setting up of projects

On its 5<sup>th</sup> anniversary, the “Project Development Support” team is now operating at full capacity within the institution and is currently responding to more than a hundred requests from research units. Nearly half of these requests relate to project set-up, and the rest to facilitation (contract facilitation, participation in seminars, meetings of economic partners, etc.) or to requests for advice on a few specific points (identification of donors, application letters, etc.).

2018 was marked by the continuing roll-out of framework contracts. Three new framework contracts were signed with SNCF-Réseau, EUROVIA and EGIS. In all, 15 framework contracts have been signed with major groups. They build loyalty and expedite the signing of agreements. They are one of the ways in which IFSTTAR's own resources which now amount to almost €20 million, from about 160 agreements per year. Over the period 2013-2018, an €8M increase in the Institute's own resources has thus occurred.

Our partners are mainly from three market sectors: road and rail transport, infrastructure and construction, nuclear and offshore energy. They ask us to carry out projects essentially related to four scientific themes that are priorities for the Institute: the circular economy, risk management, new technologies around the 5<sup>th</sup> Generation Road and the design of the autonomous vehicle from the point of view of ergonomics and new technology. In 2018, the Project Development Support team responded to requests from ADEME to test autonomous shuttles between 2019 and 2022. The ENA project (Autonomous Shuttle Testing) led by IFSTTAR was first of all approved by ADEME after which a proposal which brought together ten partners and six zones under the leadership of IFSTTAR was submitted at the end of the year. IFSTTAR has incorporated in its Goals and Performance Contract its willingness to collaborate with all types of players, including SMEs, which are generally less well integrated within innovation

## Managing and monitoring research activity

2018 is the second year of the deployment of the **SI Recherche** tool (a tool for managing and capitalising on research projects and laboratory expertise). Several new features have been introduced, including the “campaign” module, which was used to compile the projects presented in this activity report, as well as the “amendment” module devoted to the incentive mechanisms developed by the Scientific Directorate. With this module, researchers can apply for funding directly when using the tool.

In 2018, the Scientific Directorate, in conjunction with the Directorate for European and International Affairs, organised meetings to conduct reviews and explore opportunities with the departments to which the other functional directorates were invited. These meetings, which took place in November, provided an opportunity to take stock of the past year and discuss the prospects for 2019 while planning reporting activities (on the research programme and to produce this activity report). The beneficiary listening that is carried out during these meetings with the departments was reported and discussed at the CSR in December and at the COMEX at the beginning of the year. The objective is to use this feedback to make an annual improvement in the organisation of information collection methods. ●

networks. The “Innov'day” formula had been acclaimed by SMEs in 2016. It was renewed in 2017 and 2018 on the theme of rail transport. It has been opened up to our partners in the railway sector and offers SME's opportunities for networking and publicity. In addition, an event dedicated to transport sector SMEs was held at IFSTTAR's site in Bron, in collaboration with the CARA cluster, in order to introduce SMEs to the research opportunities that IFSTTAR can offer them.

With regard to Europe, 2018 was marked by the Institute gaining eight new European projects. In 2018, IFSTTAR continued its involvement in the Institutes for the Energy Transition (ITE Efficiency and Vedecom) and in the Institutes of Technological Research (IRT Railenium, System-X, Jules Verne) by continuing to provide on secondment the equivalent of six full-time equivalents per year. ●

► [FIND OUT MORE](#)



# EFFICIENT TRANSPORT AND SAFE TRAVEL



Mobility and safety issues, which are central to IFSTTAR's research, are addressed by Theme 1, whose aim is to achieve "efficient transport and safe travel". Mobility systems are crucial for the functioning of modern societies, and they must become more energy efficient, more reliable and more resilient while integrating innovative technology. They must also make the effort to understand the consequences of the automation of transport systems.

In this context, researchers are working to develop solutions that meet society's expectations, i.e. that are reliable, energy-efficient, safe and responsible, as well as suitable for all people and goods. Our teams have three goals: improving the reliability of transport, enhancing the safety and ergonomics of travel, and promoting multimodal, intelligent, clean and seamless mobility.

Five themes were specifically addressed in 2018: traffic information, infrastructure diagnosis and maintenance, road safety, with a particular focus on vulnerable users and in-company actions, not forgetting technological breakthroughs.





## TRAFFIC INFORMATION

For traffic information to benefit from the advances of digital technology, it is necessary to develop systems that can both predict the occurrence of events and transmit information to users. So-called cooperative systems allow data to be exchanged between vehicles and the infrastructure and thus improve the usefulness and dissemination of services. The work of a number of IFSTTAR researchers has helped to develop innovative services that enable drivers to adjust their speed or predict their travel time.

### The C-The Difference project – Adapting vehicle speed to the infrastructure

The objective of the project was to further knowledge in the area of cooperative ITS systems (C-ITS) in order to meet the transport needs of cities for improved and more sustainable transport. This project permitted the monitoring and evaluation of C-ITS under operational conditions in two real urban environments, Helmond and Bordeaux, by expanding the number of users and the geographical coverage of existing systems. A comprehensive impact study was conducted to determine the benefits of C-ITS systems in terms of traffic efficiency, safety and environmental impact, as well as user acceptance. The deployed services were as follows:

- GLOSA (Green Light Optimisation Service Advisory)
- RLW (Red Light Violation Warning)
- IVS (In-Vehicle Signalling)
- P+R (Park & Ride Information)

The C-The Difference pilot project delivers a comprehensive and integrated impact assessment of C-ITS services on the basis of 18 months'

operation of existing and new C-ITS services with private and professional users in urban areas. For GLOSA, more than 1,500 traffic signals were connected together in Bordeaux. Acceptability studies show that drivers reported adjusting their speed and slowing down more smoothly when approaching the traffic signal. During the trial, no improvement was observed in traffic efficiency or throughput due to the low penetration rate even if more than 800 users used the app. But the collected data shows that using GLOSA can help to achieve constant journey times which helps both users and road operators in their daily travel and in surveillance activities. ●

► **FIND OUT MORE**

**The C-The Difference project**

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#### C-ITS services displayed on a smartphone



The driver can prepare to stop, the fire will stay red



The light is green but will be red when the driver reaches it



It is advisable to reduce the speed to 27 km/h to get the green light



The next traffic light will be green

## Validation of a prototype for estimating journey times on the A35 (through Strasbourg)

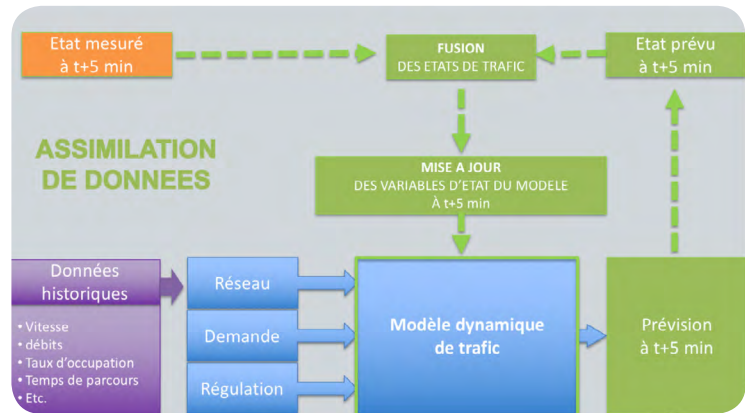
The A35 motorway is a strategic link for the Strasbourg Eurometropolis. It not only carries through traffic but also facilitates internal trips within the urban community of Strasbourg. It carries heavy traffic and generates many negative environmental and economic externalities: recurrent congestion which leads to delays and undermines economic competitiveness, noise problems, and air pollution which causes nearly 150 premature deaths per year.

DREAL Grand Est, which is responsible for the project management of the upgrading of this road, has contacted IFSTTAR in order to:

- Conduct a feasibility study detailing the design of a prototype for short-term journey time forecasting on this portion of the A35,
- Develop a prototype that provides real-time knowledge of traffic conditions and that makes short-term traffic predictions, in order to compute journey time information reliably and disseminate it to users,
- Validate the prototype based on historical observations. It has been shown to be robust as regards integrating specific events that regularly occur on the network (accidents, works).

This work provided an opportunity to test the journey time estimation prototype developed at IFSTTAR between 2015 and 2017, under real conditions in the field. This first application validated the functionalities provided by the algorithms developed within this framework and led to an initial proof of concept before subsequent deployment. ●

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Diagrammatic representation of the operation of the journey time estimation prototype

## DIAGNOSIS

The socio-economic challenges arising from safety requirements for people and equipment, the need to protect the environment and reduce pollution and achieve productivity gains from increasingly complex systems, mean that diagnosis and maintenance issues are a central concern when it comes to optimising industrial processes.

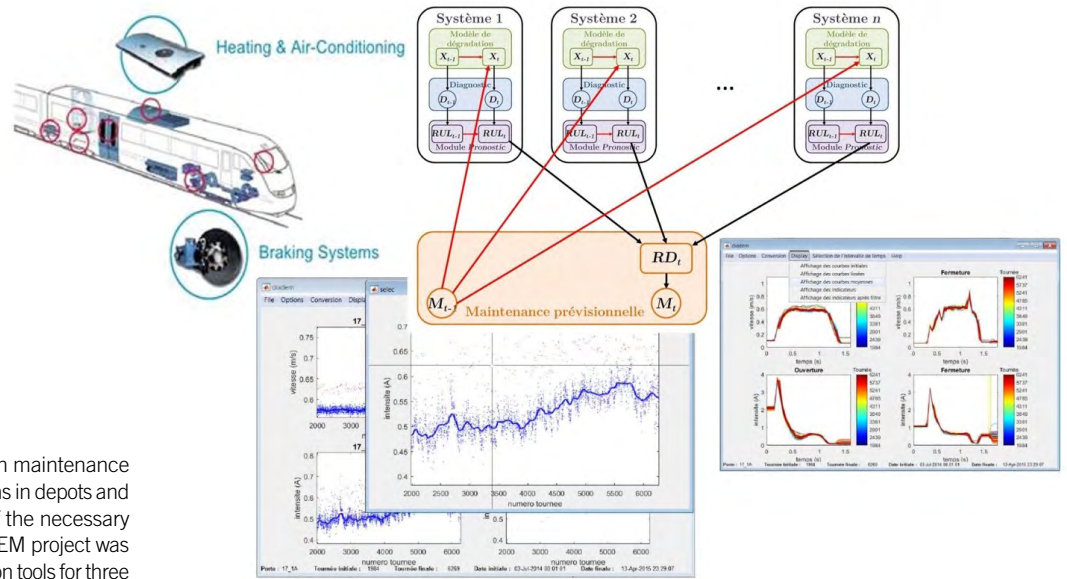
Vehicle-borne equipment offers significant potential in terms of data collection for monitoring both the operation of vehicles and the infrastructure they run on. Appropriate data processing and algorithms permit precise diagnoses for optimal maintenance or to identify defects or damage that could jeopardize safety. Thus, assessing a technical situation and developing a maintenance policy which is not only corrective and preventive but also predictive (prognosis, diagnosis, and

damage monitoring) is a major scientific and technical problem that must be solved in order to improve processes and reduce risks. This applies to the field of transport, as shown by the three topics we shall present hereafter, namely the maintenance of on-board systems on trains, the maintenance and monitoring of different types of railway lines, and the maintenance of road markings for road transport.

## The ANR DIADEM project – Dynamic diagnosis and predictive maintenance for on-board train systems

These systems are regularly inspected to ensure the rolling stock is properly maintained. The major challenge for operators is to maximise train availability without increasing costs, through conducting predictive and conditional maintenance. In this context, both manufacturers and operators look for ways of implementing conditional maintenance based on the actual state of the system and more particularly on prognosis, the aim being to anticipate equipment failures. By developing innovative tools for the diagnosis and maintenance of on-board subsystems, the





The ANR DIADEM project – Diagnosis and prediction for on-board systems on trains

operator is able to optimally plan maintenance operations, the logistics of its trains in depots and workshops, as well as supply of the necessary parts. The objective of the DIADEM project was to develop diagnosis and prediction tools for three sensitive components of railway rolling stock (the air conditioning, braking system and doors). For this purpose, tools for analysing raw data from on-board door instrumentation were proposed. With regard to prognosis, residual life estimation algorithms for discrete state systems have been developed. ●

► **FIND OUT MORE**  
The DIADEM project

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## NeTIRail-INFRA – Needs Tailored Interoperable Railway Infrastructure

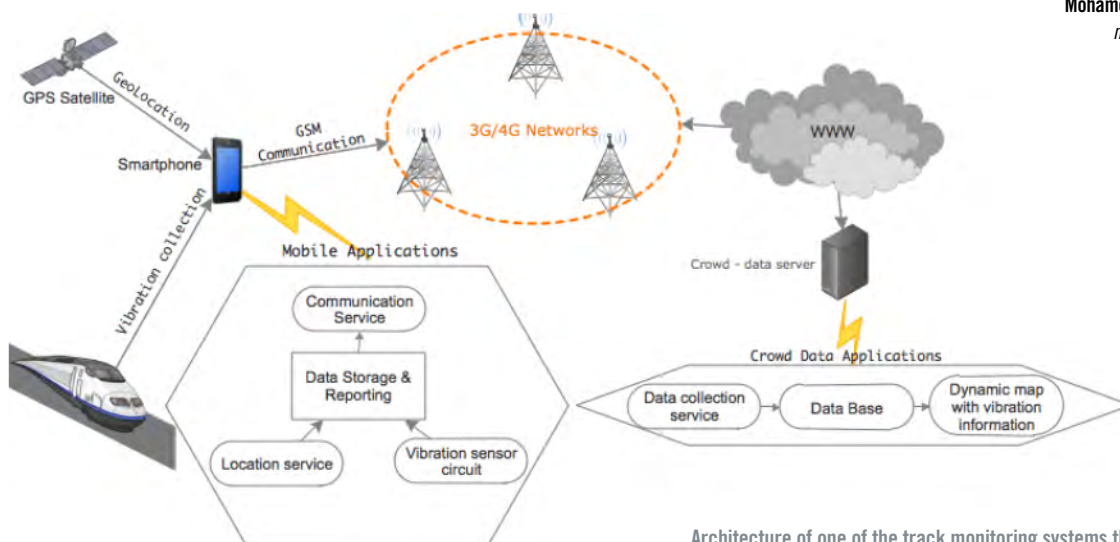
In order to improve the performance of rail operation in different operating contexts while ensuring high levels of safety and interoperability, the European H2020 programme funded the NeTIRail-INFRA project between June 2015 and May 2018. This project aimed to develop innovative technological solutions to optimise the monitoring and maintenance of different types of railway lines: saturated, mixed medium-density and low-density traffic (dedicated to freight or little used). The

monitoring solutions that were developed are based on low-cost technologies (GNSS, GSM, accelerometers) and can be deployed at the trackside and on moving trains. Under certain conditions, they make it possible to reduce the use of special “measuring” trains, which is both costly and operationally complex. The contribution of the ESTAS laboratory (COSYS departement) to this project focused in particular on analysing the operational safety of S&C (Switches and crossings), which are critical

elements for the safety and availability of the infrastructure, as well as on developing a data model that includes and correlates all the monitoring data generated by the developed solutions. Several demonstrators have been built based on the results and these have been presented at various scientific events, such as **TRA2018**. ●

► **FIND OUT MORE**  
The NeTIRail project

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Architecture of one of the track monitoring systems that has been developed

## Diagnosis of Infrastructure and Vehicle Dynamics for Motorcycles and Passenger Cars ("DYMOA" project)

The DYMOA project, which was led by IFSTTAR and conducted in partnership with CEREMA and the Assurance Mutuelle des Motards, was funded by the French Road Safety Foundation (Fondation Sécurité Routière). Its goals were as follows:

- To develop methods for diagnosing roads and their use by motorised two-wheelers (M2W). A secure on-board recorder based on a secure dedicated smartphone which fitted onto an M2W has been developed, a legal procedure has been put in place to guarantee data confidentiality (protection of personal data) in accordance with drivers' rights, and criteria for detecting incidents based on vehicle dynamic thresholds

have been defined. A fleet of 30 M2W and 10 light vehicles was instrumented. Data collection was performed for one year and covered three areas. It recorded 3,200 routes (totalling about 42,000 km) and identified 700 events and 430 incidents.

- To produce knowledge on M2W use, distinguishing between interactions with the infrastructure and the use of the capabilities of M2Ws, including driving speeds. Some types of infrastructure that pose problems for M2Ws have been identified as well as some high-risk zones. Hazardous road design features or zones were analysed. The use of the dynamic capabilities

of the M2Ws was compared with that of the light vehicles. The value of a speed monitoring system linked to the infrastructure was demonstrated. The specific infrastructure-related M2W safety issues were identified through the analysis of more than 71,000 accident cases. ●

► **FIND OUT MORE**  
The DYMOA project

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### Instrumentation des motos

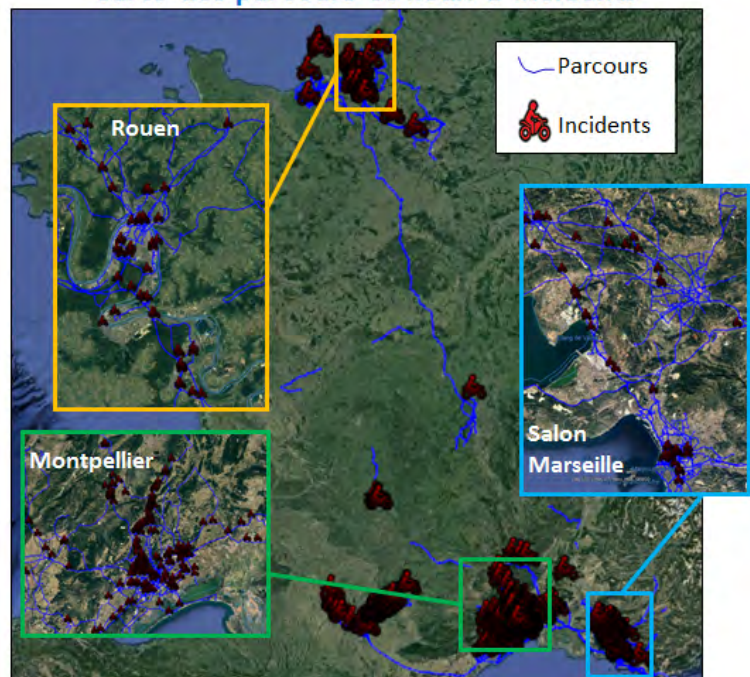


EMMA Phone



- Accéléromètres
- Gyromètres
- GPS
- Communication GSM
- Caméra

### Carte des parcours et lieux d'incidents



Data collected and journeys recorded in the 3 target Départements and the locations of the identified incidents



# SAFETY OF VULNERABLE USERS

Pedestrians, whether children or adults, cyclists and the users of motorised two-wheelers are among the most vulnerable road users because they are poorly protected in the event of a collision. Their mortality remains high and they account for a rising proportion of fatalities due to the increase in the use of active modes in urban areas. In 2018, IFSTTAR carried out several projects that address this issue in order to identify ways of making road risk awareness campaigns more effective - from school onwards - and also better understanding how accidents come about. More effective detection devices can improve the protection of pedestrians and cyclists. The behaviour of two-wheeler users, particularly on bends, has been studied in order to identify both the problems posed by the road itself and the inappropriate behaviour of certain users.

## QASPER: Quality of the Primary School Road Education Certificate

The QASPER project set out to evaluate the initial road education provided at primary school. It benefited from a grant from the Road Safety Commission (Délégation à la Sécurité Routière) in partnership with the Directorate of School Education (DGESCO). The objectives were, initially, to provide an overview of the educational activities conducted with schoolchildren, then,

secondly, to assess the impact of these activities on them, the value and effectiveness of road safety education, the relationship between the individual, socio-affective and environmental characteristics of schoolchildren and their risky behaviours, and finally to provide guidelines for increasing and improving road safety education. To achieve these objectives, several studies were

conducted between 2016 and 2018. Interviews, monitoring and questionnaire surveys were conducted targeting teachers, parents and children. For example, 68% of the 2,272 primary school teachers surveyed reported that they did actually provide an average of 8 hours road safety related teaching per year. The project resulted in recommendations for improving road safety education in schools. These included developing actions focusing on child passengers, involving parents more closely in prevention measures, and promoting positive behaviour. ●

### PERSONS INVOLVED

Bérengère RUBIO, Julien CESTAC, Jean-Pascal ASSAILLY & Jean-Marie BURKHARDT

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Initial road education at primary school

## PROSPECT (H2020): Detecting vulnerable road users

The sharing of the road environment between vulnerable users and vehicles generates specific potential accident situations due to the difficulties drivers encounter in detecting them. The purpose of the PROSPECT project is to improve the effectiveness of active safety systems that detect pedestrians and cyclists and prevent this type of accident (considering a wider range of scenarios, earlier detection, proactive analysis and faster activation).

Video footage of traffic was taken by LESCOT. Conflict situations were extracted using algorithms developed by LEOST (based on analysis of 1,080 hours of footage). This work, intended for system developers, has made it possible to compile an exhaustive collection of coded conflicts (context, trajectory and kinematics).

Several assistance strategies have been developed by the project's industrial partners (Daimler, Bosch, Conti), providing functions that range from the display of a warning to vehicle control (automatic braking or emergency avoidance). When

such systems are used, it is crucial that they are well accepted by drivers. The results of the tests conducted by LESCOT show that systems have a high probability of acceptance of PROSPECT systems: drivers were particularly positive about the warning function. They also indicated their willingness to equip their vehicles with braking and avoidance functions, even if a slightly lower acceptance rate was obtained for avoidance. ●

Advertisement for the closing seminar of the Prospect project

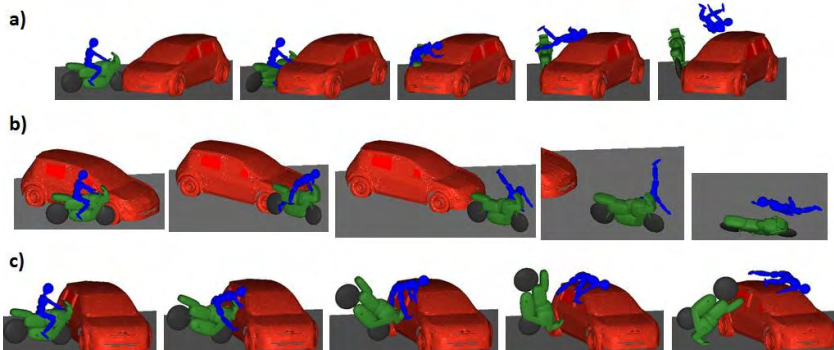
## Sécu2RM: Causes and physical consequences of motorised two-wheeler accidents

The Sécu2RM project, supported to the tune of €650k by the Road Safety Foundation, involved three laboratories from TS2 (UMRESTTE, LBA and LBMC) and a laboratory from the University of Strasbourg and Ceesar (Centre Européen d'Etudes de Sécurité et d'Analyse des Risques).

Two disciplinary approaches, epidemiological and biomechanical, were applied simultaneously to better understand the issues surrounding M2W accidents. Estimates of injury levels were based on the Rhône Registry, a dedicated survey and clinical data collection in departments providing

care for life-threatening emergencies in Lyon and Marseille in 2016.

The results reveal the issues related to the attention that motorists pay to motorized two-wheelers (M2Ws), their detectability, as well as the awareness among M2W drivers of the problems they can pose. Improving the state of pavements or providing appropriate signage is also an important way of reducing the number of M2W loss of control incidents. In terms of protection, the effectiveness of clothing designed for M2W users in order to limit the occurrence of frequent injuries such as lacerations and wounds, and that of full-face helmets to prevent certain facial injuries have been proven. When the analysis of clinical data is superimposed on biomechanical analysis, the results highlight the design and evaluation issues that make it possible to improve the regulatory framework for protective devices: improvements in the standard for helmets, a normative framework for the development of protective airbags for the chest and spine. ●



Simulation of a number of accident scenarios, with the kinematics of the M2W user

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# ROAD SAFETY AND FIRMS

A review has also been carried out to support public decision-making by providing new insights into the socio-economic valuation of personal injuries and the effects of active mobility on the health of road users.

In 2018, 3,259 people were still killed in road traffic accidents in France. In order to reduce this number, new policy levers must be found. The French government is supporting companies in their efforts to reduce occupational road risk and prevent accidents, and IFSTTAR has lent its support to the Road Safety Commission (DSR) to ensure that knowledge spreads to firms that manage a large fleet of vehicles. The company must thus develop action plans that take account of road safety on home-work journeys as well as on journeys made as part of the its staff's duties. As part of an expert assessment conducted for Butagaz, the influence of human factors on

accident occurrence was examined. At the fifth meeting of the club of employers committed to road safety, the focus was on the factors that enable users to adopt safety-conscious behaviour. Finally, during a symposium entitled "Road

safety at work: a lever for performance", various thematic sessions and a round table enabled the participating companies to provide feedback, identify good practices and the future actions to be implemented.



## Vasem: Estimating the cost of road traffic accidents

Road traffic accidents in France are a major problem for the community and result in more than 3,000 deaths and nearly 300,000 injuries every year. With a view to assessing the cost of road traffic accidents, the Road Safety Commission (DSR) provided IFSTTAR with financial support to launch a project known as the Socio-economic Valuation of Road Morbidity (VASEM). This project began in 2017 and is continuing as part of a doctoral thesis.

The cost of road traffic accidents can be broken down into five main components: human costs, medical costs, production losses, material damage and administrative costs. The first findings focused

on human and medical costs. They were obtained in part by using the Rhône Registry and the PMSI MCO database (Programme for the Development of Medical Information Systems Medicine, Surgery and Obstetrics). The human cost was estimated at €89,000 for the hospitalised casualties with minor injuries and €182,000 for casualties with severe injuries. The average short-stay hospitalisation costs for patients with minor and serious injuries were estimated at €2,242 and €10,338 respectively for 2013.

In the future, the project will seek to determine a method for estimating the costs of the other three components. The ultimate objective is to estimate

Estimating the socioeconomic costs of road traffic accidents

the socio-economic consequences of accidents for society as accurately as possible and to provide public decision-making support when prioritizing road safety measures. ●

► **FIND OUT MORE**  
The VASEM project

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## Butagaz safety day

The Detailed Accident Studies (EDA) conducted by IFSTTAR's Laboratory of Accident Mechanism Analysis (LMA) allow us to discuss the role of the human factor in the causation of road traffic accidents. These studies, which are carried out in Salon-de-Provence, are a fundamental component of accident research. The "real-time" involvement at the accident site of a team consisting of a psychologist and a technician allows a significant amount of data to be collected on the three components of the user-vehicle-infrastructure traffic system. This approach permits an in-depth analysis of the causes and mechanisms of accidents. Butagaz approached us because they wished to benefit from this expertise in the field of accident studies. Our involvement took

place as part of the "Butagaz safety days" event. After presenting some general knowledge about driving and human functioning, we proposed an analysis of a number of Detailed Accident Studies. We showed the audience that the very design of the traffic system means humans have to move in a complex, variable, evolving and uncertain

environment. It is their ability to act by correcting their mistakes that allows humans to drive. Human error is not a primary cause of accidents but the consequence of malfunctions that occur at an earlier stage. A film of our presentation is available on the Butagaz intranet site. It serves as an awareness-raising tool for the company. ●

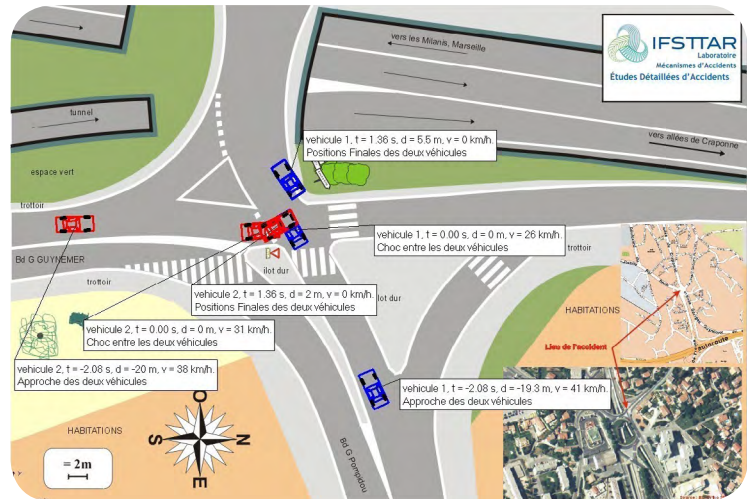


Diagram of an EDA accident reconstruction

## IFSTTAR works with companies that are committed to the safety of work-related travel

On 11 October 2016, in the presence of the Ministers of the Interior and Labour, twenty-one business leaders announced seven firm commitments to ensure the safety of their employees' work-related journeys. They decided to organise meetings to allow signatory companies to share resources and work together on effective communication measures to combat work-related road risk. At the end of 2018, nearly 1000 business leaders had signed up to these commitments. The fifth meeting of the club of employers committed to road safety was held on 7 October 2018 at the

National School of Administration (École Nationale d'Administration - ENA).

The morning session was intended to discuss the results and the measures implemented by five invited companies in order to fuel a collective discussion that would identify new courses of action. The morning's proceedings began with a brief presentation on the adoption of prudent behaviour by a researcher from IFSTTAR. This helped to clarify the contributions from three branches of psychology (cognitive, developmental and social) to identifying levers for action for

companies (awareness of the stages involved in behaviour change and the need to modify action accordingly). The SNCF Group's Deputy Director of Occupational Health and Safety, the Occupational Safety Manager of IBM France, the Corporate Risk Prevention Manager of AXA Prévention and Covéa's Occupational Health and Safety Manager then presented their respective assessments and action plans. Networking between the stakeholders will provide an opportunity to continue the dialogue.

On December 17, 2018, the second national symposium on road safety at work was held on the topic of "leveraging performance", during which companies came to share their experience. It should be noted that road traffic accidents account for more than half of all fatal work-related accidents. Every year, nearly 500 people die in this way, either on their way to or from work or while performing their duties and ten times more will suffer very serious after-effects. Nearly 6 million working days are also lost as a result.

The purpose of this day-long event was to gather ideas and arguments that will help to convince companies of the merits of the initiative. Several round tables were held on employee training, alcohol- and telephone-related risks while driving, corporate mobility plans and technological innovations. ●

A round table during the event on 18 December 2018



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# TECHNOLOGICAL AND SOCIETAL DISRUPTIONS

Transport systems generally undergo continuous change in terms of improvements in their operation and maintenance. Sometimes, a technological advance can disrupt this slow process and cause a complete disruption. These can be either technological, and in principle manageable, as in the case of electronic components, or societal, as in the case of autonomous vehicles. In this case, they require a form of assimilation that is made possible as a result of media-based information.

## The MeGaN Project, a French Gallium Nitride (GaN) power component sector

The project aimed to develop a French GaN-based component sector for power applications. The desired disruption is to achieve high levels of energy efficiency with the possibility of operating in severe and very confined environments and reducing the weight and volume of devices. Such performance is made possible by “large-gap” semiconductor materials such as Silicon Carbide (SiC), GaN or diamond.

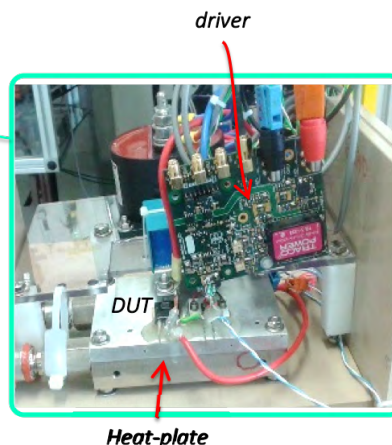
The applications targeted were traction and recharge converters for automotive batteries as well as photovoltaic and aeronautical applications. Begun in 2012 and completed in 2018, this project, which was funded by the French

Investment Bank (BPI), was built around end-users (Renault, Safran, Schneider Electric), manufacturers (Valeo, Loutot, Id-mos, Tronico) and academics (CEA-LETI, CNRS, INSA-Lyon, ARMINES, Université de Grenoble and IFSTTAR) at a total cost of €45M.

The project produced components up to 100A and 650V using HEMT (High Electron Mobility Transistor) technology and the design of a colaminated material (copper/Invar) which made it possible to develop a package that is suitable for high temperature environments. IFSTTAR’s ageing platform has identified the main failure modes of these components. The work has led to the defence of two theses at TEMA and a number of scientific publications. ●

Ageing test rig for power components

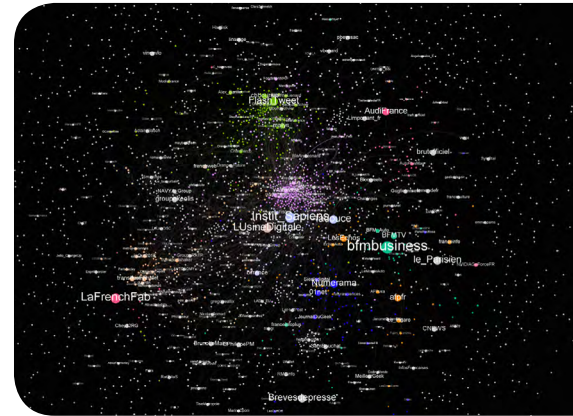
PWM test bench



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Main communications media analysed



## The autonomous vehicle as a media object

Funded by DGITM-MTI, the VACOM project analyses how the autonomous vehicle is portrayed and presented in the French and English media coverage. The discourse in question was collected from the so-called “mainstream” print and Internet media, and on the so-called “social” media of Twitter, between December 2017 and May 2018, as well as in a selection of French, American and English national newspapers between 2012 and 2018. This data collection provided details about the volume and origin of the information disseminated about the autonomous vehicle as well as the problem framework. Since 2015, the subject has occupied an increasing but nevertheless unstable place in media discourse. A significant event leads to a high level of media coverage in the press and more widespread interest on Twitter (otherwise, only about fifty accounts mention the topic), but also to a homogenisation of content. The sources of information are the same for everyone, and authors have become skilled in the art of reprocessing other people’s articles. When two similar events (e.g. a fatal accident) follow one another, media reporting does not build on previous coverage to increase its profile. Approached mainly from the point of view of private actors, autonomous driving is still neither a topic for society nor a fully-fledged public issue. ●

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# INTERNATIONAL ACTIVITIES

Some of IFSTTAR's activities extend beyond our borders. In 2018, the Institution actively participated in the organisation of international events (symposia and conferences mainly aimed at promoting stress-free mobility) and encouraged the development of international partnerships between research laboratories carrying out specialized activities that address major societal challenges, such as preserving the mobility of pedestrians over the age of 65. These actions help to enhance the institution's profile.

## Mobility, areas and smart cities: How to reconcile innovation with inclusion?

During the 2018 Jacques Cartier Meetings, a symposium was jointly organised by IFSTTAR (TS2 laboratory - LESCOT, Bron) and Laval University (CIRRIIS) in Quebec. Organised on 13 and 14 November 2018 at IFSTTAR's site in Bron, its aim was to provide a space in which to think about innovation and inclusion issues. Indeed, in the face of the proliferation of mobility-related innovations, with the emergence of new modes of transport (autonomous vehicles, new personal or public urban transport modes) as well as new

services and smartphone applications, we must ask, to what extent, and how, these innovations can meet everyone's needs, or even make it possible to include people who were hitherto restricted in their journeys. Work was presented by participants from Quebec and France in the fields of inclusion and innovation (16 presentations spread over 1 1/2 days). This conference provided opportunities for discussions between researchers, local and regional authorities and those attempting to identify ways of developing innovations for mobility that meet the needs of all, particularly the disabled and the elderly. ●

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## A special issue of the journal IET Intelligent Transport Systems has been devoted to distraction and inattention

The conference on "Driver Distraction and Inattention" organised by IFSTTAR, Safer (the Chalmers and Volvo Cars Vehicle and Traffic Safety Centre) and AARB (Australian Road Research Board) was held at the IFSTTAR Marne-la-Vallée site in January 2017. The following year, a special issue of the journal IET ITS was published to draw attention to the five best papers from the conference. The first paper deals with attention issues related to the use of autonomous vehicles, in particular the critical transition from automatic to manual operation. The authors highlighted a variety of preventive measures to address the effects of inattention and provided several avenues of research for understanding and managing

distraction and inattention. The use of smartphones is a major concern for road safety. The second paper presents new ways of measuring the impacts of smartphone use by young drivers. The results reveal not only that young people make intensive use of smartphones, but also that they may underestimate this use while driving. Human-machine interaction is also being studied to reduce potential human deficiencies due to fatigue. Using behavioural and physiological data, the authors explored how driver participation in a conversation with a personal digital assistant (PDA) can increase wakefulness and improve driving performance. A final paper focuses on touch screens which can cause distraction. The



Symposium held at IFSTTAR's site in Bron as part of the 2018 Jacques Cartier meetings,

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authors highlight the importance of designing touch screens that are integrated with the vehicle. The 2020 edition of the conference is scheduled to be held in Lyon. This event will be an opportunity to make the Transpolis testing facility known internationally to researchers in the humanities and social sciences and to foreign manufacturers in order to encourage the setting-up of European and even international projects. ●

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Participants at the IPIN2018 at the *Cité des Congrès* in Nantes

## IPIN2018 International experts in the field of indoor geolocation met for the 9<sup>th</sup> international conference on Indoor Positioning and Indoor Navigation.

Organised by the Géoloc laboratory and held between the 24 and 27 September in Nantes, IPIN brought together more than 300 researchers and manufacturers from 37 countries who are experts in “ubiquitous geolocation technologies.” They presented the work they have conducted to support new forms of intelligent and connected mobility and the sharing of indoor location data for the Internet of Things. The four-day event was punctuated by two masterclasses, 97 oral research presentations, 33 posters, and 4 keynotes given by international experts. The American professor Andrei Shkel explained how a glass of wine inspired the invention of a blown glass gyrometer. J. Redelkiewicz, from the European GNSS agency, detailed the technological innovations required to support the automation of transport modes: ubiquitous trace calculation, better accuracy, more data exchange and increased geolocation security. A geolocation

competition was organised to coincide with the conference. Fifteen teams of researchers and manufacturers took part with the aim of geolocating themselves as precisely as possible and in real time by following a path marked by 180 targets scattered throughout the 9,000 m<sup>2</sup> of the Nantes Atlantis shopping centre. In particular, the conference strengthened IFSTTAR’s national and international profile in the field of indoor geolocation. Participants in the next edition will meet in Pisa (Italy) in September 2019. ●

► **FIND OUT MORE**  
The IPIN conference

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## Forming international partnerships to better understand osteoarthritis and maintain independent mobility

Osteoarthritis is a disease of the cartilage that affects the knees of about one in four people once they reach the age of 65. Most of these people can no longer carry out daily activities such as walking or climbing stairs, which severely limits their independent mobility. A long-standing partnership between the LBMC (IFSTTAR - Université Lyon 1) and the LIO (ETS - CRCHUM), involving specialists in biomechanics and surgeons, aims to better understand the biomechanical factors responsible for the progression of this disease and improve diagnosis and patient care.

Several studies have been carried out as part of jointly supervised PhDs and Master’s degrees, and researcher mobility funded by the Jacques Cartier Centre, the Auvergne-Rhône-Alpes region and IFSTTAR’s DAEI. The research approach is based on an analysis of movement performed with an innovative device coupled with bi-plane imaging and validated musculoskeletal modelling. This work has shown relationships between knee anatomy, joint movement and cartilage loading. Ongoing work is studying different osteoarthritis treatments that can maintain or restore mobility (orthopaedic prostheses and knee replacements). Movement analysis and bi-plane imaging are clinical methods used in a number of hospitals, in Lyon and Montreal for example. Musculoskeletal modelling is becoming more common, but its application is still limited to research. ●

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Study of knee movements during walking coupled with morphology and skeletal alignment and stress in muscles, ligaments and on the contact surfaces of the joint







# MORE EFFICIENT AND RESILIENT INFRASTRUCTURE

The scientific activities of Theme 2, which relate to “Resilient and efficient infrastructure”, were marked in 2018 by current events, which reminded us of the importance of maintaining our existing, sometimes ageing, infrastructure. The national road audit identified a significant need for investment to upgrade and maintain infrastructure that is subjected to increasing use and exposed to new types of stresses, as a result of climate change in particular. The imperatives of the ecological and solidary transition also require us to seek materials that are less energy-consuming and more environmentally friendly, without sacrificing mechanical properties and durability. The infrastructure must not only be economical in its own right, but also help to reduce the environmental impact of mobility. Modifying infrastructure is one of the goals we are pursuing, and there have already been some achievements in this area. The development of a circular construction economy is a second goal that is described in this activity report. Finally, new transport infrastructure that will help bring about the ecological and energy transition, particularly in the context of the 5<sup>th</sup> Generation Road, and new renewable energy production and transmission infrastructure, complete the picture for the year 2018.



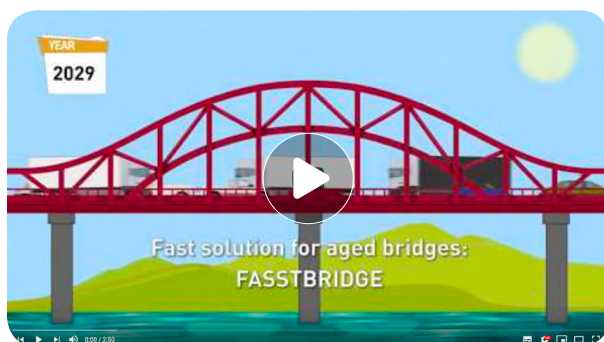
# MODIFYING INFRASTRUCTURE

Four achievements illustrate the initiatives undertaken at IFSTTAR to modify infrastructure in order to meet current and future demands, as well as to enhance its sustainability and resilience.

A European project (FASSTbridge) proposed assessment approaches and composite-based strengthening techniques for metal structures. An interdepartmental research project backed up by a doctoral thesis focused on the detection of scour at bridge piers, in collaboration with a laboratory specialised in hydraulics affiliated with CEREMA. The ECODERM research project proposed non-destructive evaluation and testing methods using electromagnetic technologies for pavement layers and concrete

masonry structures. The DEDIR project has resulted in the development of a low-cost technique for checking the condition of pavements by measuring their deflection basin. The vehicle-mounted systems in question use infrastructure management support software. The closing days of the DEDIR project were in May 2018 and were attended by researchers and the representatives of project owners and industry. The ALIZE-LCPC software has been updated and reprogrammed.

## FASSTbridge – Fast and effective strengthening to extend the life-time of steel bridges



The FASSTbridge project (Fast and effective strengthening solution for steel bridges life-time extension) aimed to provide a complete solution using bonded composites for increasing the service life of metal structures (particularly with regard to fatigue). This solution includes a methodology for assessing the existing structure,

sizing the strengthening and its application on an instrumented site as well as strengthening with a bonded composite strengthening system developed specifically for the project. The entire solution was applied to a real structure owned by the Madrid community of municipalities: the Jarama Bridge. This made it possible to verify the effectiveness of the proposed solution and to assess its merits with a cost-benefit and environmental analysis. The project was coordinated by TECNALIA with the following partners: the Community of Municipalities of Madrid, Dragados (Spain); LAP, MPA Stuttgart (Germany); Collanti (Italy); Altavista (United States), and IFSTTAR (France). IFSTTAR's SMC, EMGCU and Navier laboratories took part. A closing seminar was held during the CICE International Conference which took place in Paris from 17 to 19 July 2018. Two films were produced (one on the concept and the second on the on-site installation process) and 2 articles were published in international journals as well as 14 papers in international conferences with published proceedings. ●

► **FIND OUT MORE**  
The FASSTbridge project

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## Vulnerability of engineering structures to scour

Collaborative work with Saint-Venant hydraulics laboratory (EDF R&D, École des Ponts Paris-Tech and CEREMA)

Scouring is the removal and transport of sediment from the bed of a river due to the erosive action of flowing water. This phenomenon is accentuated by the presence of obstacles to flow, such as bridge piers and abutments, and also, in a marine context, quays, wind turbines and offshore oil pipelines. Scour pits reduce the load-bearing capacity of a structure and jeopardize its stability. In the context of this hydraulic risk, it is crucial to continuously monitor changes in the depth of scour in the vicinity of engineering structures and to assess their impact on the performance of the structure.

This research is based on the use of vibration analysis to monitor scouring and makes a contribution to the understanding of the soil-structure interaction phenomena involved. The selected scientific method incorporates two distinct approaches to scour monitoring: indirect and direct. The indirect method used a scour depth sensor (SDS) that is currently being developed. Experimental and numerical studies were carried out to evaluate the influence of scour on the dynamic response of the sensor (frequencies, modal deformation and damping) and on its static response under lateral loading. Based on our findings, a theoretical model of an equivalent beam was proposed to link the variation in sensor frequency to the scour depth. The direct approach focuses on the effect of scour on the dynamic response of the structure itself. Test campaigns were carried out on scale models in hydraulic channels. Particular attention

was paid to the effects of the geometry of the pile and the interaction between the pile and the bridge deck. An analytical model has been proposed to predict how the frequency of piers will change as a consequence of scour. In order to validate this model, its results were compared with those of the experimental tests. ●

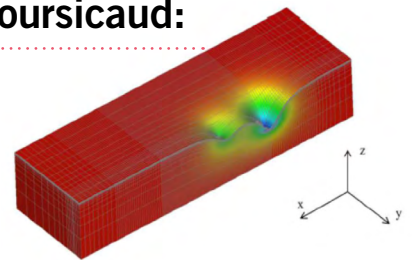
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## PhD thesis by Vincianne Le Boursicaud:

Measurement of the deflection basin to characterise pavement condition, funded as part of the DEDIR research project

Vincianne Le Boursicaud's thesis, defended on November 8, 2018, focuses on optimising the interpretation of deflection measurements in order to evaluate the structural characteristics of a pavement. Until now, only the maximum deflection and the radius of curvature have been analysed. First, the research developed a method to correct measurement biases resulting from the operation of the measurement devices. It then developed a methodology for calculating orthogonal indicators that are particularly sensitive to certain structural characteristics and that uses the entire measured signal. The resulting indicators are more sensitive than those used conventionally. They thus permit not only the detection of defects - like conventional indicators - but also their location on the x-axis and their characterisation in terms of their depth and nature. The entire body of work was validated not only by digital studies, but also by experiments on



Simulation of the deflection generated by a curvimeter on a pavement with interface debonding © Jean-Marc Martin, IFSTTAR-MAST-LAMES

test sites. Finally, the application of the methods was successfully tested on measurements obtained over a 20 kilometre route. ●

► **FIND OUT MORE** The DEDIR project

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Illustration showing CODEM © IFSTTAR and CEREMA

## ECODEM - Non-destructive assessment and monitoring of dispersive media in civil engineering by electromagnetic wave propagation

The ECODEM research project (Non-destructive assessment and monitoring of dispersive media in civil engineering using electromagnetic techniques), which was scheduled to run for 4 years (2014-2017), ended with a national presentation day, open to staff of the French national technical network, academics, local authorities and major contractors, on January 29, 2019. The main partnership between IFSTTAR (GeoEND, S2I and the LAMES laboratories in Nantes) and the CEREMA research team (ENDSUM) has led to research work that has been described in numerous scientific publications (28 in high impact factor journals), thesis defences (6), accreditations to supervise research (2) and designs for measurement equipment and antenna-equipped robots (5). A scientific report containing the main findings is due to be released shortly. These include the

development of non-destructive assessment methodologies for the physical and geometric characterisation of infrastructure using frequency hopping radar techniques combined with the waveform inversion of radar signals, as well as the electromagnetic characterisation of materials (hydraulic and bituminous mixtures) in relation to durability indicators and condition parameters, which is useful for structure managers. Full-scale experiments on platforms and test sites have validated the methodologies in real and controlled situations. ●

► **FIND OUT MORE**  
The ECODEM project

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# DEVELOPING THE CIRCULAR ECONOMY

IFSTTAR contributes to the development of a circular construction economy by offering recycled materials, in particular obtained from deconstruction, for the construction of the Rennes metro (NEOVAL project) and road structures (see the RILEM recommendations).

## State of the art report on cracking and debonding in pavements - RILEM report

After the MCD2016 conference and the recommendations published in Materials and Structures, RILEM Technical Committee 241 fulfilled its goals by publishing, with Springer in June 2018, a **State of the Art report of the RILEM TC 241-MCD** (2018, doi: 10.1007/978-3-319-76849-6). TC 241-MCD, chaired by Professor Bill Buttlar (University of Missouri, USA) and assisted by Armelle Chabot, (IFSTTAR / MAST), has collected knowledge of a more fundamental nature than in the past on the mechanisms of cracking and debonding in bituminous and composite pavements. Within it, the three interrelated technical groups (TG) on cracking (TG1 by Eshan Dave, University of New Hampshire, USA), debonding (TG2 by Professor Christophe Petit, University of Limoges, France) and measurements (TG3 by Gabriele Tebaldi, University of Parma, Italy) gathered contributions from more than 15 countries, which they compiled and discussed before conducting a final revision in 2017. The book also drew on some contributions



from members of the former TC 210-CAP on Cracking in Asphalt Pavements, between 2004 and 2011. In conjunction with the publications of MCD2016 and the TG2 recommendation on interface debonding tests (Materials and Structures, vol. 51(4), 2018), this volume contains field observations, laboratory test results, and a state-of-the-art report on modelling and existing advanced measurement systems that can best describe the observed phenomena. ●

### ► FIND OUT MORE

**Recommendation of RILEM TC 241-MCD on Interface Debonding Testing in Pavements** (2018, doi: 10.1617/s11527-018-1223-y)

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## NEOVAL - Expert appraisal of the rolling structure for Line B of the Rennes NEOVAL

In the context of the construction of the new Rennes metro line, IFSTTAR has been involved in assessing the longitudinal evenness of the continuously reinforced concrete rolling structure, by successfully modifying conventional highway measurement devices.

Siemens wished to evaluate the longitudinal evenness of the continuously reinforced concrete rolling structures of the future metro. This criterion reflects the level of comfort passengers travelling in rubber-tyred trainsets experience. IFSTTAR has shown on a covered section of about 1.2 km long that the measurement tools and methods traditionally used for highways (MLPL, Unibox) can be applied to these new structures, with a few modifications, such as the distance between sensors to take into account the greater axle width, or a lower measurement speed in some places. The measurements led to an accurate assessment

of the levels of evenness, especially in the short and medium wavelengths, which correlated with visual observations of the quality of the structure. These results should also feed into the industry's ongoing deliberations on the specifications for evenness on such structures for exclusive right-of-way public transport.

In addition, some earlier projects have generated National Projects. The certification of two National Projects led by IFSTTAR with **IREX** is noteworthy.

- **FastCarb**: CO<sub>2</sub> sequestration by recarbonation of recycled concrete aggregate. An international workshop **CO2STO** will take place in June 2019 under the patronage of the AFB, the FB, the AUGC and RILEM.
- **Terre Crue**: this National Project, certified at the end of 2018, aims to promote local construction techniques for raw earth buildings by using local materials, often excavated, and by helping to



NEOVAL: Instrumented vehicle on a rolling test track

develop a high performance methodology that exploits the environmental qualities. ●

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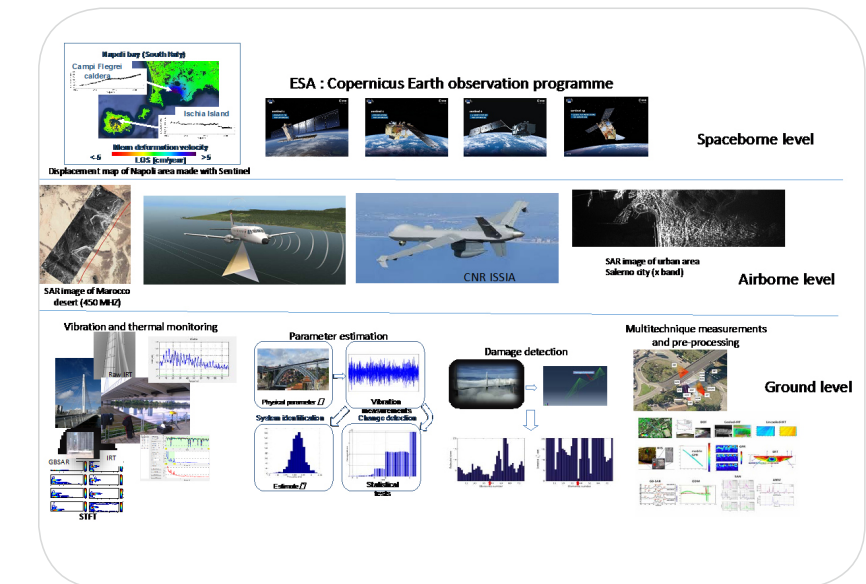
# NEW ELECTRICITY TRANSMISSION AND PRODUCTION INFRASTRUCTURE

An Associative Laboratory has been set up that brings together IFSTTAR, international partners, and an Italian organism, in order to develop future technologies for the electromagnetic monitoring of infrastructure. In addition, a non-destructive technique for the structural monitoring of offshore wind turbines has been developed. Finally, the European FABRIC project has been completed with IFSTTAR's support.

## International Associative Laboratory “Advanced Sensing laboratory for Transport Infrastructures” (LIA-ASTI)

An associative laboratory has been created bringing together IFSTTAR, CNR (IREA and IMAA) and INRIA that is devoted to developing new fundamental knowledge that will provide the basis for the infrastructure monitoring methodologies and procedures of the future.

This laboratory will take on an international dimension under the name “Advanced Sensing laboratory for Transport Infrastructures” (LIA-ASTI) with IFSTTAR, INRIA from France and CNR IREA and IMAA from Italy. The objective of LIA-ASTI is to explore the fundamentals of electromagnetic solutions for the multispatial and multitemporal infrastructure monitoring of the future. These solutions use emerging technologies ranging from ground-based satellite sensors to high-performance computing and multi-physics modelling. LIA-ASTI focuses on civil engineering structures in both urban and interurban areas, taking account of spatial density and variability as well as dispersion. Significant methodological advances are expected from the modelling of combinations of multiple wave-material interactions and advanced computer methods to pre- and post-process the huge data set generated by remote sensors such



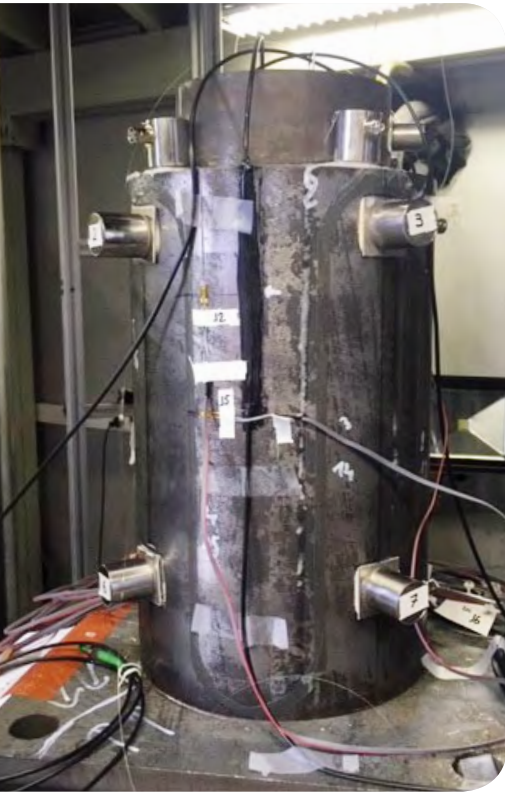
The Copernicus earth observation programme led by the European Commission in partnership with the European Space Agency (ESA) and the European Environment Agency (EEA)

as DinSar or GBSaR coupled to other ground-based sensor networks. Close collaboration will permit state-of-the-art research capable of producing ground-breaking scientific results. The three institutes of the consortium complement each other, and are recognised for their leading role in civil engineering, DinSAR, radar imaging

and IT at the European level. They share the same vision of applied research for society. ●

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An instrumented specimen

## SHM-GROUT: Structural Health Monitoring for offshore wind turbines

Grouted connections are frequently used to join metal tubes in offshore environments, particularly in the oil and gas sector. This technique has also been applied in the offshore wind turbine sector to connect the structure (jacket or monopile) to its foundation. However, the dynamic forces experienced by wind turbines are very different from those that occur on offshore platforms. In 2009-2010, in the North Sea, progressive settlement was observed on nearly 600 of the 988 “monopile” offshore wind turbines. This damage was undetected before it had created significant geometric changes. The SHM-Grout project, funded by the Weamec regional centre, aims to evaluate the effectiveness of several non-destructive methods for detecting and

monitoring damage to this type of connection. In partnership with the University of Nantes, and with the participation of STX, IFSTTAR’s SMC and SII laboratories have designed a small sample of this type of grouted connection, instrumented it with several sensor technologies and subjected it to axial fatigue stresses. Although the results of the instrumentation are still being evaluated, it can already be stated that the tested methods could have detected the damage. ●

### CONTACT

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## European FABRIC project

Improving the efficiency of the energy supply to vehicles requires the greater deployment of electric vehicles. The most effective solution for recharging batteries is undoubtedly the large-scale development of dynamic, contactless charging facilities that can be used by all types of vehicles: private cars, public transport and freight transport. The European FABRIC project in which the VEDECOM Institute took part with the support of IFSTTAR has made possible the creation of such a demonstrator for charging electric passenger cars, on the Versailles-Satory test site. ●

► **FIND OUT MORE**  
 the FABRIC project

Versailles-Satory  
 test site

## EXPERT ASSESSMENTS OF EXISTING STRUCTURES

A major assessment exercise took place in 2018, which was based on research into the durability of materials, the understanding of diseases and damage mechanisms, non-destructive diagnosis methods and the development of repair and strengthening options. Some of this research has resulted in standardisation, namely publication of the standard NF P 18-451 for UHPFRC (Ultra High Performance Fibre-Reinforced Concrete). IFSTTAR's participation in international groups ensures it maintains its status as an expert (RILEM, ACI, fib action group MC2020...). ●

## COMMUNICATION ACTIVITIES FOLLOWING THE COLLAPSE OF THE MORANDI VIADUCT IN GENOA

After the collapse of the Morandi Viaduct in Genoa in August 2018, IFSTTAR received many requests to comment on the event and the possible risks to other structures, particularly in France. Experts from the Institute appeared before the Senate Committee on Bridge Safety information.

An expert assessment was carried out on the Pont de Normandie (2017-2018) to evaluate the potential effects of the passage of exceptional loads and provide decision support to the authorities representing the State and to the structure's concession holder.

The SMC laboratory (Metallic and Cable Structures), conducted an expert assessment of the disorders affecting cable structures (even recent ones) and hence the R&D needs of structure managers with regard, for example, to monitoring and materials with enhanced properties. The Laboratory has worked on many of France's major bridges (Normandy, Millau, Saint-Nazaire, etc...). In 2018, six major expert assessments were carried out on cable bridges, including the Boulonnais viaducts and the Île de Ré bridge, as well as on cable car cables such as on the Aiguille du Midi. This work has made it possible to launch a number of R&D initiatives to meet the

needs of managers, such as Shape Memory Alloys for cable damping, coupled fretting and fatigue mechanisms in the event of corrosion; the use of non-destructive methods to monitor the condition of cables in their anchorages; the detection

of defects in cables using vibration methods, and new biosourced coatings for anti-corrosion protection. ●

The Île de Ré bridge © CD 17





# SIGNIFICANT EVENTS IN 2018

## CICE 2018 – 9<sup>th</sup> International Conference on Fibre- Reinforced Polymer (FRP) Composites in Civil Engineering

The 9<sup>th</sup> International Conference on Fibre-Reinforced Polymer (FRP) Composites in Civil Engineering was held in Paris, France from 17 to 19 July 2018. Since its launch in 2001 in Hong Kong, the CICE series of conferences has travelled to Adelaide (2004), Miami (2006), Zurich (2008), Beijing (2010), Rome (2012), Vancouver (2014) and Hong Kong (2016). CICE is one of the official conferences of the International Institute for FRP in Construction (IIFC). The conference was jointly organised by IFSTTAR, École des Ponts ParisTech and Université Claude Bernard Lyon 1. In keeping with the longstanding tradition of this conference series, CICE 2018 aims to provide an international forum where engineers, researchers and practitioners in the field of civil engineering composites can discuss and share recent advances and ideas for the future.

This conference attracted more than 300 researchers and engineers from 40 countries and benefited from the support of industry (Freysinet, S&P, Mapei...). The main themes discussed were:

- External reinforcement using bonded composites,
- Reinforced concrete structures with internal FRP internal reinforcement,
- “All-composite” structures. ●



### ► FIND OUT MORE

The CICE2018 conference

### ✉ CONTACTS

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## The IABSE “Tomorrow’s Megastructures” Symposium, Nantes 17-21/09/2018

The International Association for Bridge and Structural Engineering (IABSE) has members in 100 countries and boasts 51 national groups worldwide. It deals with all aspects of structural engineering: the planning, design, construction, operation, monitoring, inspection, maintenance, rehabilitation, conservation, demolition and dismantling of structures, taking account of technical, economic, environmental, aesthetic and social aspects. The purpose of the Association is to exchange knowledge and advance the practice of structural engineering worldwide in the service of the profession and society.

Organised by IABSE and AFGC, the Tomorrow’s Megastructures Symposium was held in Nantes with the support of IFSTTAR and involved 575 participants, with 6 keynote lectures and 300 publications. ●

### ► FIND OUT MORE

The “Tomorrow’s Megastructures” Symposium

### ✉ CONTACTS

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The Tomorrow’s  
Megastructures Symposium:  
B. Godart, chair of the  
organising committee





# PLANNING AND PROTECTING REGIONS

IFSTTAR has been dealing for many years with issues related to the environment, natural and climatic events, as well as the risks posed to property, people and infrastructure. The upsurge in climatic and natural events that are deemed to be exceptional prompts us to find innovative solutions to help to adapt to and plan for these risks, but also to take account of new forms of mobility. IFSTTAR's research topics therefore cover these themes - with a particular focus on the development of urbanised areas - and aim to reconcile the growing needs for space, mobility, supply or energy with the need to protect populations and the environment from pollution and natural or malicious threats. ●



# FORESEEING NATURAL AND CLIMATIC RISKS

To address this theme which is part of Goal 7 in Theme 3, research takes into account seismic risk. This is well illustrated by the Co-Quake project, which aims to explore an alternative way of avoiding earthquakes by inducing controlled low magnitude earthquakes.

IFSTTAR is also notable for its cutting-edge research on the quantitative characterisation of the subsoil and infrastructure? The ANR HIWAI project addresses this issue, both to help create sites for new technology (onshore or offshore wind power) or to monitor sites, structures or areas with high human impact.

Current events remind us that protecting infrastructure from rockfalls is still a central subject for IFSTTAR teams and the Montagnole rockfall station (38) has once again been used to test the behaviour of sands under low speed impact loading with an application to the dimensioning of soil layers that protect structures from rock impacts. It should be noted that this research received recurring financial support from the DGPR in order to perform the tests and analyse

the results and that a thesis was defended in December 2018 on this subject.

From the point of view of scientific events, IFSTTAR is regularly the setting for high-level meetings bringing together a large number of researchers and practitioners. In 2018, the Ninth National Geotechnical and Engineering Geology Days (JNGG) were held at the Marne-la-Vallée site from 13 to 15 June 2018. The theme of these days, "Resources and facilities, what are the limits?" perfectly illustrated current concerns, highlighting the need for any human action that involves exploiting resources or developing and building new infrastructure to respect certain limits in order not to pose an irreversible threat to the ecosystem. ●

## CoQuake (Controlling earthquakes)

A team of young researchers led by IFSTTAR's Ioannis Stefanou (from the Geotechnical Engineering Team at the Navier Jointly-Managed Research Unit) obtained funding from the European Research Council in 2018 for an ERC Starting Grant project known as CoQuake. The project proposes to explore an alternative and innovative way of avoiding catastrophic earthquakes by causing smaller, controlled, earthquakes. Earthquakes are natural phenomena linked to the plate tectonics and they cannot be avoided. The CoQuake project will demonstrate that they can be controlled to reduce their impacts on assets and people. CoQuake goes

beyond the current state of the art by proposing innovative approaches to evaluate the effects and consequences of various techniques for activating seismically active faults. The project is based on the development of large-scale spatial simulations of fault systems, based on behavioural laws derived from micromechanical simulations of grain interfaces, taking into account thermo-hydro-chemo-mechanical coupling (THMC). The aim is to eliminate the need to use ad-hoc empirical behavioural laws that require calibration. A pioneering experimental programme, based on the design and construction of a new metric-scale measurement device, will test the validity of the CoQuake project's hypotheses and the feasibility of predicting the behaviour of sliding surfaces using the proposed modelling approach. ●



CoQuake



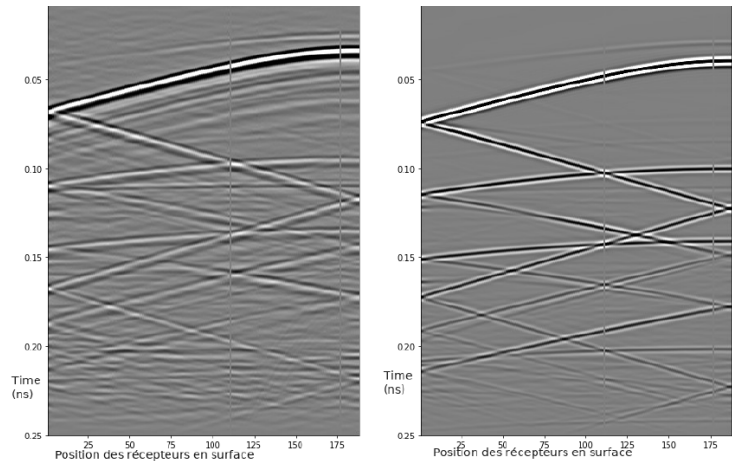
► FIND OUT MORE  
The CoQuake project

## The HIWAI Project

In the context of energy transition and climate change, there is a growing need for the characterisation and quantitative imaging of the subsoil and infrastructure, whether it is to help create sites for new technology (onshore or offshore wind power) or to monitor sites, structures or areas with high human impact (dikes, classified sites, risks related to urban environments, etc.). Full Waveform Inversion (FWI), which considers the entire seismic wave field to accurately reconstruct the parameters of the environment, has been successfully applied in deep prospecting for hydrocarbons. However, the method is currently based on local optimisation. This means that it is very difficult to implement for near-surface environments for reasons to do with pre-existing information and the non-unique nature of the solution. Faced with these difficulties, the ANR HIWAI project (led by Yann Capdeville, from the Laboratoire de Planéologie et Géodynamique at the University of Nantes) proposes an innovative alternative approach that applies a 2-step process “by inversion of the homogenised model and downscaling”: the first is based on the result of waveform inversion of a homogenised model at the scales of the propagated wavelengths and the second is based on inversion by global optimisation of the reconstructed parameters to obtain

a model that can be interpreted in terms of the parameters sought for the targeted applications. IFSTTAR’s activities within the HIWAI project aim to test and modify the approach with regard to feasibility and robustness to measurements on the basis of reduced-scale experimental developments using the MUSC measurement rig. The first step consists of testing the methodology on non-attenuating media using 2D emission protocols. To do this, 2018 provided an opportunity to design the first aluminium models containing a vacuum based on digital tests, to manufacture the models, to carry out measurements and to analyse the recorded signals by comparing them

with the digital simulations. The Figure shows the results of measurements on the left and numerical simulations on the right from a source line. The various seismic echoes recorded are used to reconstruct the parameters of the deep environment. ●



Seismic measurements made with MUSC (on left) and numerical simulations (on right) © IFSTTAR/GeoEND

► [FIND OUT MORE](#)  
The HIWAI project

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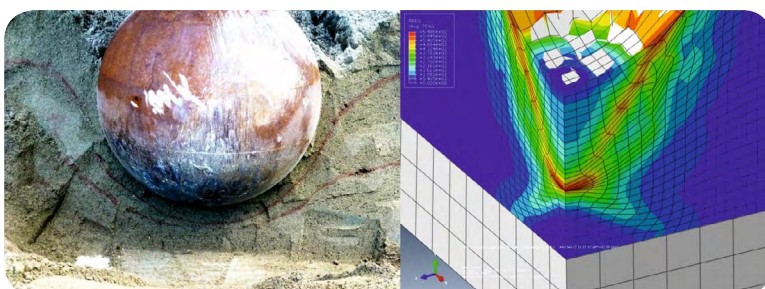
## The behaviour of sands under low speed impact loading - Application to the design of soil layers protecting structures from rock impacts

The use of a layer of sand to protect a structure from rock impacts is a time-honoured technique. However, we still know little about its capacities and limitations. A campaign of instrumented experimental tests has been conducted to characterise the spatio-temporal distribution of the pressure generated at the interface between the protective soil layer and the structure, under various impact configurations characterised by

sand thickness (D), equivalent boulder diameter (B, or its mass) and free fall height (H, or impact velocity). The full-scale tests were conducted at the IFSTTAR station in Montagnole. The experimental parametric study included 43 tests, incorporating different values of D, B and H which were comparable to those encountered in practice, up to a mass of 7.5 t at a speed of 90 km/h, impacting a 2 m thick layer of sand

protecting a reinforced concrete slab. Analysis of the tests made it possible to establish an expression for the spatio-temporal distribution of the pressure generated at the ground-structure interface during an impact. The parameters of this expression are specific to the nature and compaction of the protective sand. In the case of the size and impact velocity of the boulder determined by the hazard study, the dynamic design of the structure can be performed based on a pressure pulse generated by the model that passes through the protective soil layer. ●

The experimental test (left) and the computation (right) © IFSTTAR/RR0



► [FIND OUT MORE](#)  
The Montagnole rockfall station

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## Ninth National Geotechnical and Engineering Geology Days (JNGG) jointly organised by ENPC and IFSTTAR

Under the aegis of the French Committees for Soil Mechanics and Geotechnical Engineering (CFMS), Rock Mechanics (CFMR) and Engineering and Environmental Geology (CFG), the Ecole des Ponts ParisTech and IFSTTAR hosted the Ninth National Geotechnical and Engineering Geology Days (JNGG) from 13 to 15 June 2018 in Champs-sur-Marne. These days were organised by the Navier Laboratory (CERMES - the

Geotechnical Engineering Team) and the GERS department (SV and SRO laboratories). The theme was "Resources and facilities, what are the limits?" The concept of limit includes that of risk - natural or anthropogenic - and the acceptability of projects to the population, and highlights the need to go beyond current practices and knowledge in order to optimise projects. It therefore implies the essential concept of innovation that must guide

the directions taken by our disciplines, whether in research and teaching institutions, design offices or contractors. As in previous years, these days also hosted a technical exhibition for the various members of the profession. ●

► **FIND OUT MORE**  
The 9<sup>th</sup> JNGG



## UNDERSTANDING, ASSESSING AND MITIGATING ENVIRONMENTAL AND HUMAN IMPACTS

Air pollution and noise are transport's two main externalities, and their adverse impacts on health are proven. The WHO has just highlighted in a recently published guide that noise poses a major threat to the environment and public health.

IFSTTAR studied the health impacts of exposure to aircraft noise in the context of the DEBATS study, whose novelty lies in its several-year follow-up and the various impacts studied (disturbance, impact on sleep, as well as pathophysiological effects). IFSTTAR is also working on quantifying and characterising the noise emitted by vehicles

(such as public transport vehicles) and modelling its propagation in order to better predict and manage the noise environment in which we live. Regarding air pollution, considerable progress has been made in recent years to limit vehicle emissions. The characterisation of pollutant emissions from vehicle exhaust continues to be

the subject of much research. On the other hand, non-tailpipe particulate emissions have been less studied, despite the fact that they pose an equally significant health risk and are completely unregulated. This is a gap in our knowledge that IFSTTAR is trying to fill, through the CAPTATUS project in particular.

## The DEBATS Project - Effects of Aircraft Noise on Sleep

Aircraft noise is a significant nuisance and a major public health problem, particularly with regard to sleep disruption. Ali-Mohamed Nassur's research, for a PhD thesis which was defended on 7 December 2018, set out to better understand and quantify the effects of aircraft noise on the sleep quality of people living near airports in France, by differentiating between sleep quality, as assessed subjectively using a questionnaire

and objectively using an actimeter (a watch that records the body's movements during sleep). To meet these goals, the data collected in an epidemiological research programme known as DEBATS (Discussion on the Effects of Aircraft Noise on Health) were analysed. The existence of a link was demonstrated between exposure to aircraft noise at night and the quality of sleep assessed by questionnaire

and characterised by a risk of reporting less than 6 hours of sleep per night and of feeling tired upon waking. A link was also observed between exposure to aircraft noise and objective sleep quality parameters with an increase in sleep time and duration of intra-sleep awakening, a decrease in sleep efficiency, but also an increase in total sleep time and time spent in bed (the latter can be interpreted as a mechanism for adapting to sleep deprivation). Finally, a significant increase in heart rate amplitude during a noise event caused by the passage of an aircraft and the maximum noise level of that event was found.

These results, most of which are similar to those obtained by the majority of studies in the international literature, confirm that exposure to aircraft noise can reduce sleep quality, whether it is assessed subjectively by means of a questionnaire or measured objectively. ●

► **FIND OUT MORE**  
The DEBATS project

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## The OPALHA2 Project - An Open-Source computation code for acoustic prediction in complex architectural spaces

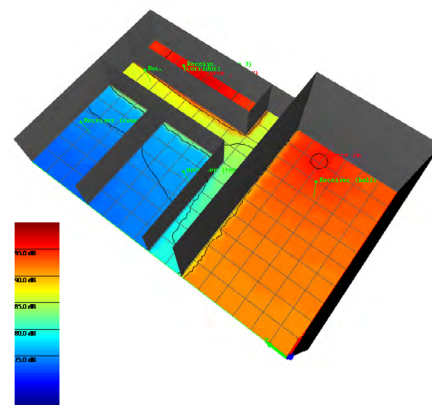
The OPALHA2 project focused on the development of an acoustic prediction tool for architectural and urban environments, which can be applied in complex coupled spaces in order to overcome the limitations of traditional prediction tools in this type of space. This tool is based on a scattering model, which calculates the spatial and temporal distribution of sound energy in a complex and diffuse space using scattering equations. Although this model has already been studied in the past, further work was needed to improve its performance (due to scientific obstacles), and also to propose a functional computation code. We have therefore focused on studying the behaviour of the model in specific cases, for which the scattering model has sometimes been found to be defective: in the presence of mixed reflection conditions on walls, in the direct vicinity of coupling zones and for elongated geometries. At the same time, we

have developed a dedicated computation code (MD\_Octave), which is embedded within the I-Simpa acoustic simulation platform. A large amount of work has also been done to take advantage of the research that has been carried out around the scattering model (and more broadly the I-Simpa environment), through the free dissemination of all the source codes and the availability of resources on a dedicated web site. ●

► **FIND OUT MORE**  
The I-Simpa project

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Application of the MD computation code to noise level mapping in a set of coupled locations  
© IFSTTAR/UMRAE





## Bus noise emissions - Expert assessment for Keolis/Rennes

In 2018, IFSTTAR was asked by Rennes Métropole to evaluate the noise emissions of an electric bus and a conventionally powered bus that is typical of the current fleet of vehicles running on the Rennes public transport network (STAR) which is operated by Keolis Rennes.

This experimental campaign, based on measurements made under conditions that are representative of actual vehicle use (steady speeds, acceleration and deceleration phases), shows clear noise emissions benefits for the electric bus under speed conditions for which rolling noise is not the principal source. The results obtained are fully in line with what has been observed elsewhere on other electrically powered vehicles. ●

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Bus noise emissions

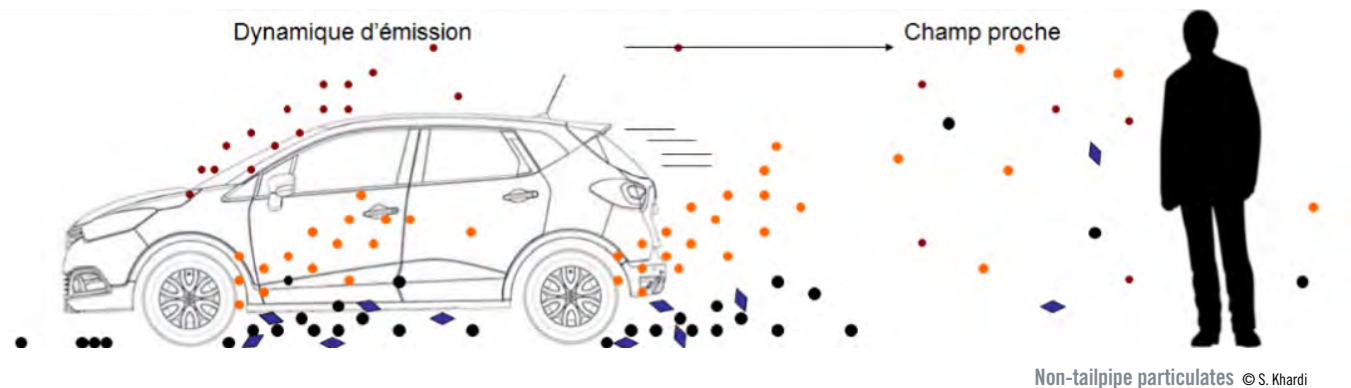
## The CAPTATUS Project

This project is funded by ADEME and aims to characterise non-tailpipe particulate matter, both physically and chemically. These particles are generated by friction in the engine compartment, brake system or during tyre-road contact. Monitoring and collection of these particulate emissions was performed on engine roller benches, test tracks and roads. The tests revealed significant changes in the chemical composition of PHEs, their particle size and emission dynamics with driving style, as well as the characteristics of the vehicle and the infrastructure. This has made it

possible to propose driving styles that can limit the intensity of non-tailpipe particulate emissions. Finally, chemical indicators and particle size signatures were proposed in order to track these particulates in the atmosphere around roads. ●

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# CONTRIBUTING TO SUSTAINABLE DEVELOPMENT

Urban areas both generate and experience multiple problems that interact with each other. Urban land use planning therefore requires collective thinking, with multi-domain approaches based on a large amount of varied data. IFSTTAR is actively engaged in addressing this challenge through its involvement in networks and the production of tools that are tailored to address this complexity.

So, whether it is for stormwater management, the maintenance of their road network, or the management of mobility and logistics within their area, local authorities need knowledge and tools to inform and facilitate their decision-making. IFSTTAR is committed to actively responding to these needs by developing tools and knowledge that will enable local and regional authorities to respond to the major challenges of the ongoing energy, ecological, climate and demographic transitions.

## The MATRIOCHKAS Project (ONEMA – Agence de l’Eau Loire-Bretagne)

To cope with the effects of increasing urbanisation, local authorities are changing stormwater management methods making greater use of facilities that permit the storage or seepage of stormwater runoff from urban surfaces. Traditionally designed in a centralised manner, the structures in question (retention basins) are increasingly being installed near the places where runoff is generated (green swales, trenches, etc.). The stormwater that enters these structures becomes an environmental issue because of the impact of the micropollutants it carries on the quality of aquatic environments and soils. The Matriochkas project focused on evaluating the performance of these structures, from the hydrological and purification point of view, through experimental monitoring of 2 basins and one swale in the Nantes Métropole area and 2 pilot swales installed by the CSTB. The observations, which were shared with those made in Île-de-France (Roulepur) and Lyon (Micromegas), showed the value of alternatives that encourage rainwater seepage with regard to reductions in both the volume and concentrations

of micropollutants, mainly metal trace elements. A diagnosis tool based on the analysis of geographical data has also been deployed at the urban area level to prioritize structures on the basis of the pollution that could affect them. ●

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A green swale in the Bottière-Chenaie district of Nantes in rainy weather - Dedicated instrumentation has been installed at the entrance and exit of the swale to estimate its performance in terms of hydrology and purification © IFSTTAR/LEE





## OGSEER - Optimisation of the Socio-Economic and Environmental Management of Maintenance Works on a Network, by geographical analysis of the area and determination of the impacts of worksites

OGSEER, an IFSTTAR internal Targeted Initiative project, aimed to study the socio-economic and environmental impacts of transport network maintenance projects in order to identify the most appropriate decisions, taking into account the interests of both society and users. The research resulted in several advances regarding the scheduling of maintenance work on a transport network: Extensive analysis was carried out to identify usable open data databases. A dictionary of data sources with format specifications has been prepared.

- A “comprehensive” database architecture was developed to host different sources. Links between different sources were established for more efficient exploitation.
- A computer tool has been created in order to retrieve the various databases, carry out the necessary conversions and transfer them to the central database.
- Based on the collected data, an indicator calculation demonstrator was developed. Thus, two “environmental noise” indicators (defined in the EVITA project) were computed by using a noise propagation simulator.
- Analyses were carried out using statistical and geographical analysis tools. The thematic analysis of the area covered (“population, trips, economic activities, etc.”) makes it possible to characterise the importance of a transport link

in order to prioritize works. An expert assessment was conducted on behalf of a manager to evaluate and measure the socio-economic role of a transport route. ●

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Disturbance  
caused by urban  
roadworks

© Le Télégramme - Morlaix  
le 21 juin 2012



## The Built2Spec project

IFSTTAR, as an IRSTV member, participated in the Built2Spec project funded by the European H2020 programme. This 4-year project (2015-2018) was coordinated by Nobatek and brought together 20 partners from 8 countries. Built2Spec aimed to apply a set of innovative technological advances to facilitate self-inspection, non-destructive testing, management and quality checking, in order to help construction stakeholders achieve the EU's energy efficiency objectives and implement new standards for more sustainable construction. Through its experience in the field of infrared thermography and the optimisation of the energy performance of buildings, the SII laboratory (COSYS department) has been involved in studying the problem of the in-situ thermal characterisation of shells. Work was carried out in a climate-controlled chamber (providing variations in environmental conditions during testing that reflect natural conditions).

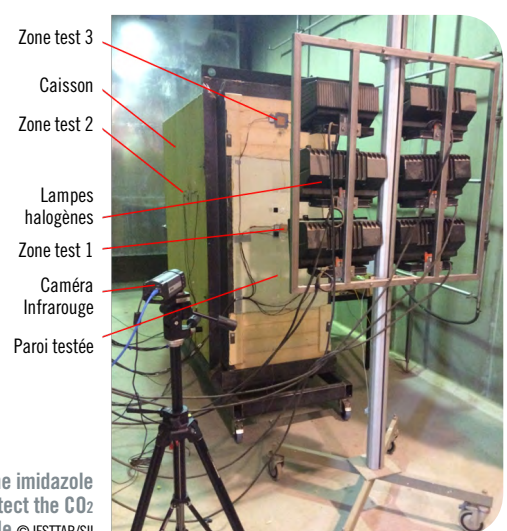
A cabinet containing a temperature-controlled heating system was built into the enclosure in which walls of various types were installed. In collaboration with the Bordeaux-based I2M laboratory, a range of instrumentation options were studied, such as using a Peltier module as a fluxmeter as well as the use of active methods to identify the thermal properties of walls. ●

### FIND OUT MORE

**The Built2Spec project**

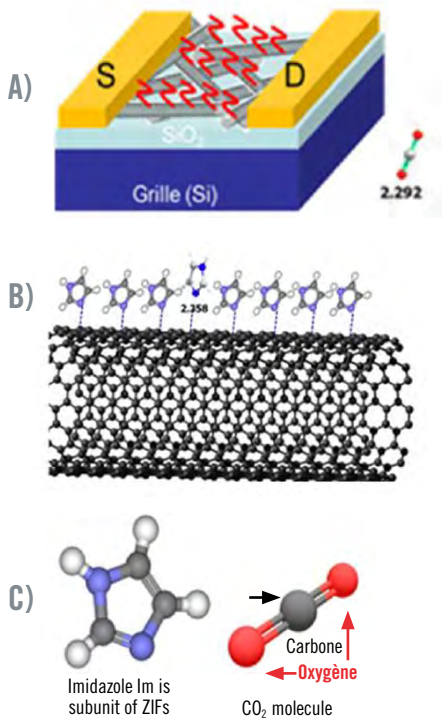
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Using the imidazole  
molecule to detect the CO<sub>2</sub>  
molecule © IFSTTAR/SII

## The SUPER BQR project: Development of sustainable materials for housing: summary, characterisation and modelling



The Super BQR project brings together teams from the MSME at UPEM and LISIS at IFSTTAR to design new functionalised carbon nanotube (CNT)-based CO2 gas sensors and to model two-phase turbulent flows at separate interfaces in order to describe the structure of new coatings for use on future housing materials. For the sensor (LISIS), carbon nanotube-based sensors have a very high sensitivity to a large number of gases such as NO2, NH3, CO and CO2. This is an important feature in fields as diverse as environmental

monitoring, agriculture, human safety and medicine. The difficulty lies in distinguishing between the gases (selectivity). As a result of this project, it was possible to detect a specific gas by applying the principle of functionalisation - i.e. the creation of trapping sites on the carbon nanotubes. The imidazole molecule was chosen because of its good affinity with CO2. It was possible to design a new sensor that provides good CO2 detection which, thanks to the combination of carbon nanotubes and imidazole, is both sensitive and inexpensive. Research is in progress to improve the selectivity of transistors based on functionalized carbon nanotubes. ●

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### Using the imidazole molecule to detect the CO2 molecule

- A) CO2 sensors at the base of a carbon nanotube transistor  
 B) Functionalization of the imidazole molecule  
 C) CO2 and imidazole molecules

## The CITYLAB Project

CITYLAB is a European project that ran from 2015 to 2018 as part of the European Commission's Horizon 2020 programme. The project was led by TOI, the Norwegian Institute of Transport Economics. CITYLAB is based on the "living lab" concept, which can be defined as a forum for consultation, design and implementation that provides support for a project. Seven Living Laboratories were designated in Oslo, Paris, Rome, London, Brussels, Amsterdam and Southampton. The City of Paris was also involved in the project and participated in close partnership with IFSTTAR. In each of these laboratories, an innovative urban logistics experiment was conducted, evaluated and, if deemed successful, suggested to other European cities. For Paris, the urban logistics initiative conducted and evaluated within the framework of CITYLAB was the "logistics hotel", an innovative building catering for urban activities (offices, housing, business and leisure) and logistics. Two buildings were involved, one which was already operational (the Beaugrenelle logistics space) and the other under construction

at the time of the CITYLAB project (it was opened in June 2018). This is the Chapelle International project, in the north of Paris. One of CITYLAB's main focuses has also been the establishment of an Urban Freight Data and Trends Monitoring Centre, which was run by the IFSTTAR team. This Monitoring Centre has produced three deliverables, in 2016, 2017 and 2018, on data and trends relating to logistics sprawl, e-commerce deliveries and service-related mobility. ●

### FIND OUT MORE CITYLAB

### CONTACT

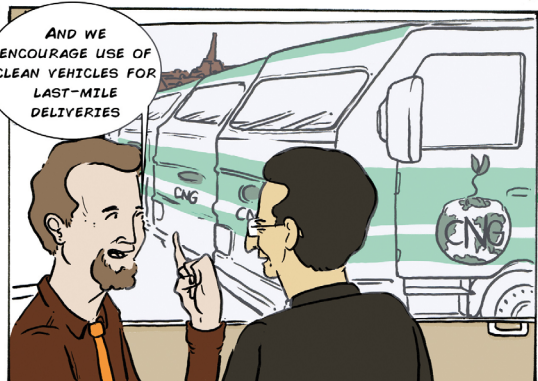
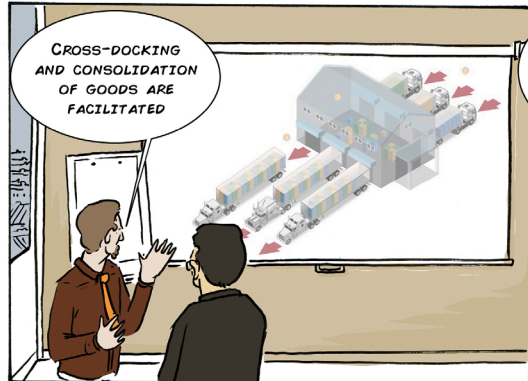
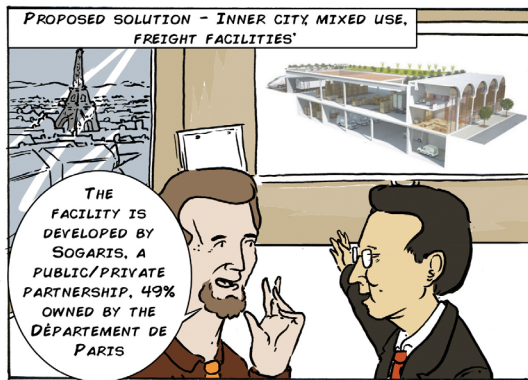
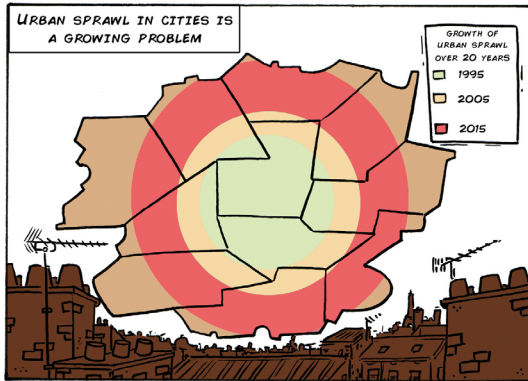
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▶  
Artwork showing the  
CITYLAB Concept  
© Matt Sloe





# PARIS LIVING LAB







# some key figures

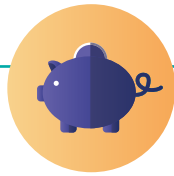
Find out about all the highlights

[CLICK HERE](#)

[→ RETURN TO CONTENTS](#)



# CONTRACTS 2018



€18.3M

**Revenue in 2018  
from research contracts**  
(including €107k from Sense-City  
and €3.4M from TRANSPOLIS)



€19.7M

**Total amount  
from notified orders  
in 2018**



162

**Notified orders  
in 2018**

## GOALS FOR RESEARCH CONTRACTS

as at 31/12/2018

### GOAL 1

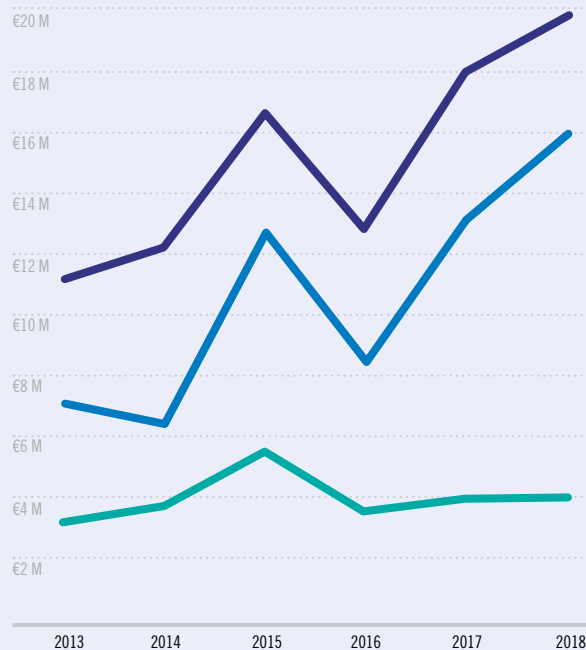
Increasing internal  
resources by means of  
research contracts

### GOAL 2

Giving priority to research  
contracts that generate  
profit margins

### GOAL 3

Developing ties with the  
world of industry



### RESULT

+ €6.9 M

### RESULT

Clear rise  
in contracts

### RESULT

Moderate  
increase  
in contracts

Transpolis



Agreement by the  
Lyon area local  
authorities to provide  
**€9.3M** of funding for  
the TRANSPOLIS project.



144

contracts completed

15 contracts in 2018

which received more than  
€200k in aid: 2 ANR, 1  
ADEME, 6 Europe, 1 FEDER,  
3 Industry, 2 DAC.

15

391

ongoing contracts



## PHD ACTIVITIES

### • THESIS DEFENCES



Efficient  
transport and  
safe travel

•  
**26**  
defences



More efficient  
and resilient  
infrastructure

•  
**26**  
defences



Planning  
and protecting  
regions

•  
**15**  
defences



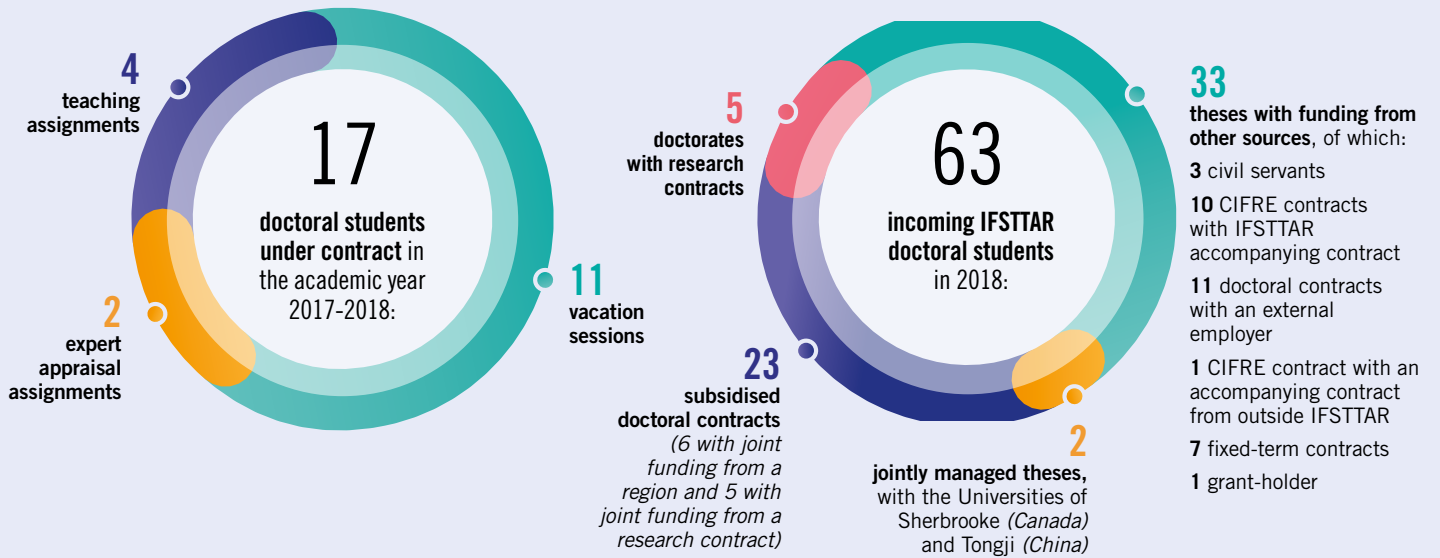
**642**  
theses defended  
since IFSTTAR's  
creation

• **67** theses defended in  
2018 with a median  
research duration of  
3.16 years

• **9** accreditations to  
direct research  
awarded in 2018

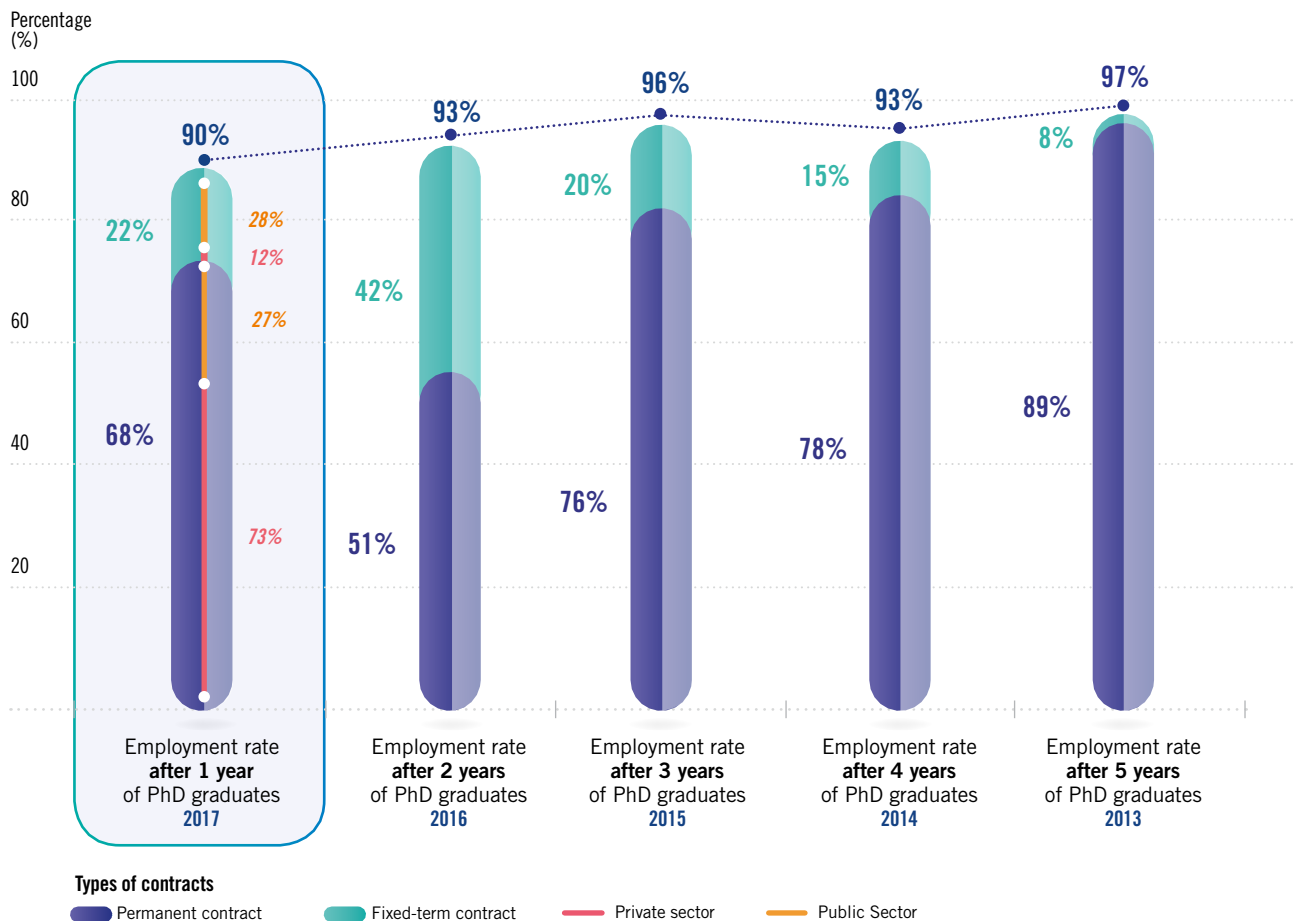


## THE DOCTORAL STUDENTS



## Employment rate of PhDs after 5 years, according to type of contract and sector

(Response rate 97%)



# HUMAN RESOURCES



**1,046**

**IFSTTAR staff**

Amounting to 1,020 full-time equivalent posts of which 791,2 are permanent



**630**

Men

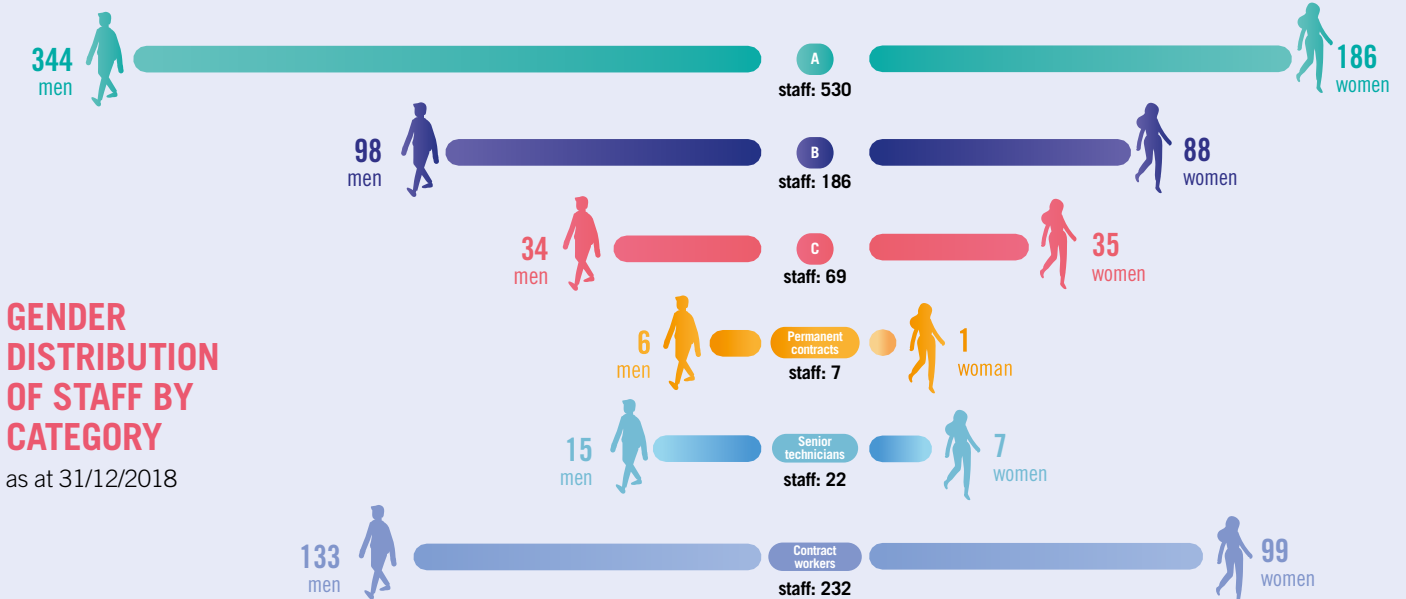
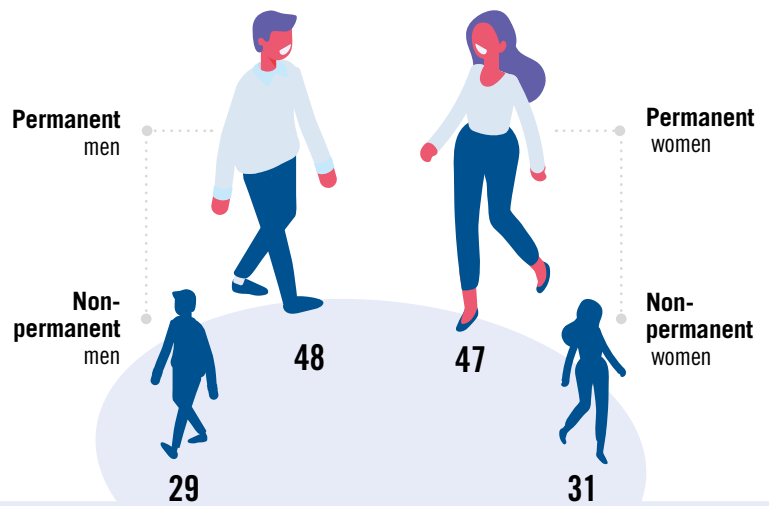


**416**

Women

## DISTRIBUTION OF STAFF BY AVERAGE AGE

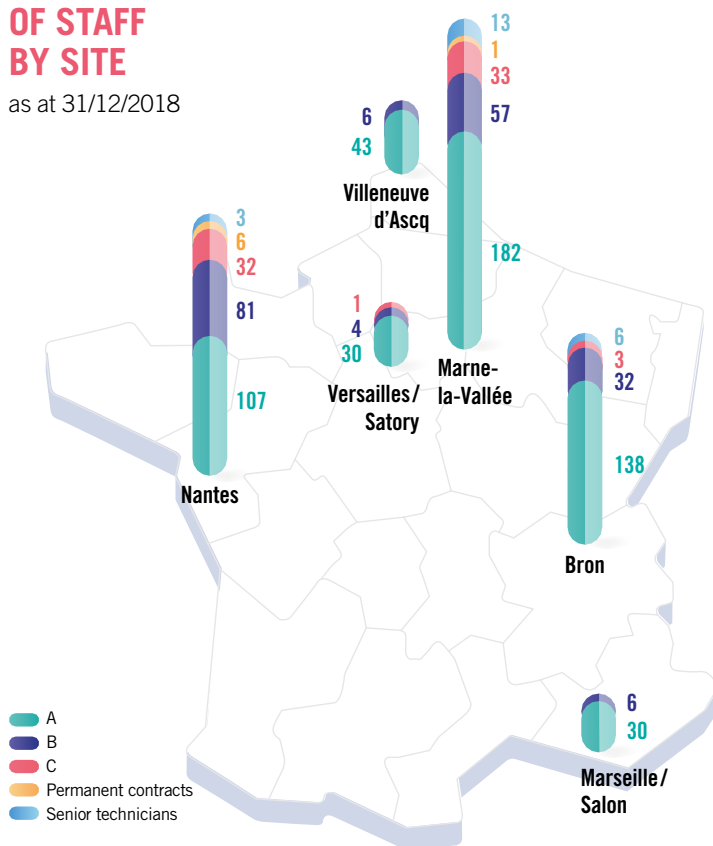
as at 31 December 2018





## DISTRIBUTION OF STAFF BY SITE

as at 31/12/2018



## Number of physical employees and Full-time equivalents

as at 31/12/2018

	Physical staff	Full-time equivalents
Researchers	301	298.2
Technicians	311	307.7
Administrative staff	234	231.5
<b>TOTALS</b>	<b>846</b>	<b>837.4</b>

## Staff by research theme

Expenditure on staff	Subsidy	Own resources
<b>THEME 1: Efficient transport and safe travel</b>	€ 18,607,303	€ 2,612,291
<b>THEME 2: More efficient and resilient infrastructure</b>	€ 15,306,617	€ 1,288,379
<b>THEME 3: Planning and protecting regions</b>	€ 21,767,522	€ 842,436
<b>TOTAL FOR RESEARCH</b>	<b>€ 55,681,442</b>	<b>€ 4,743,106</b>



# €14,442,501

Action for the entire institution  
including the promotion of research

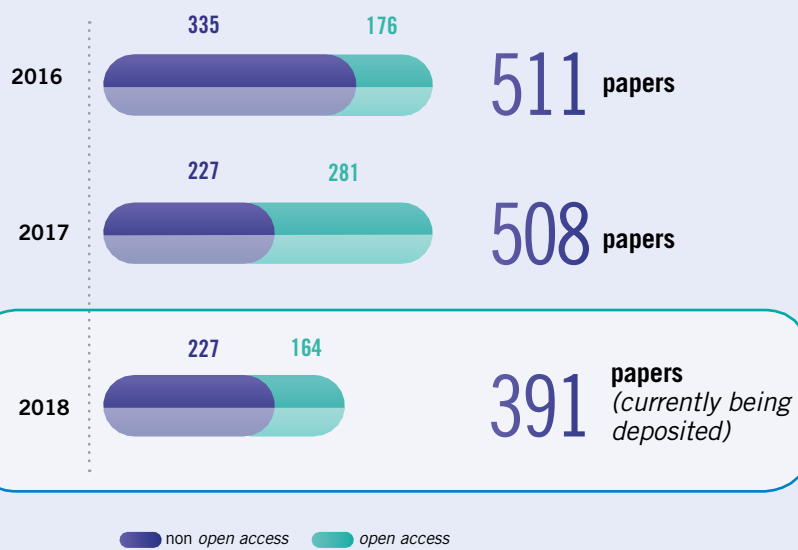
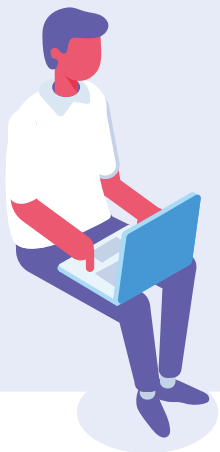
# €23,993,753

Support functions

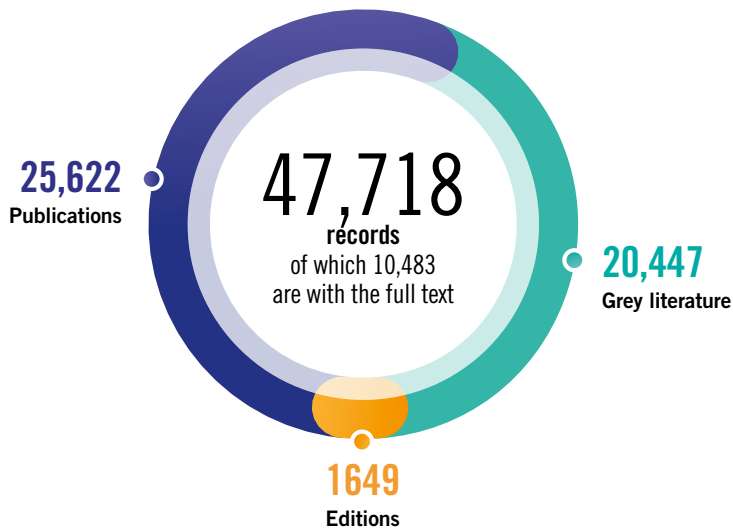
# PUBLICATIONS

## PAPERS IN PEER-REVIEWED JOURNALS

2016-2018



## MADIS institutional archive



Also available on our website:

[REVIEW OF PUBLICATIONS](#)

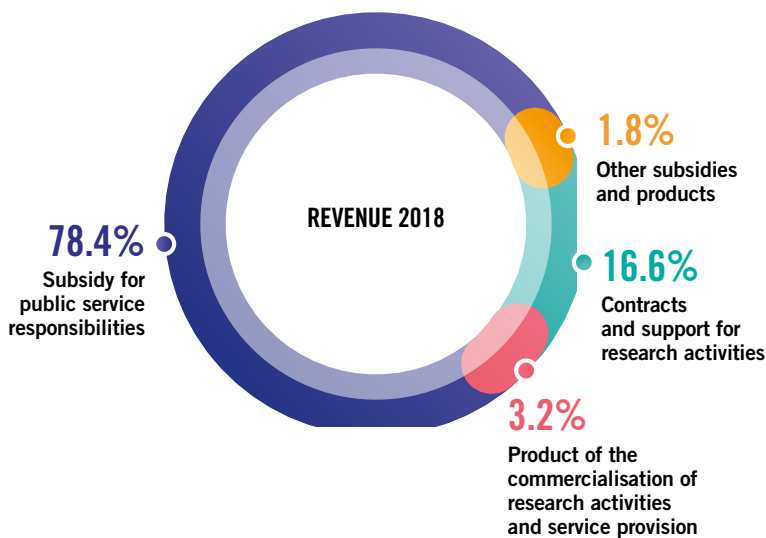
[SUMMARY OF PUBLICATIONS](#)



# REVENUE AND EXPENDITURE

## FINANCIAL RESOURCES AND EXPENDITURE EXCLUSIVE OF DEPRECIATION

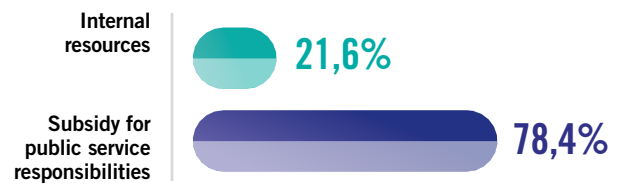
Breakdown of revenue  
(executed budget)



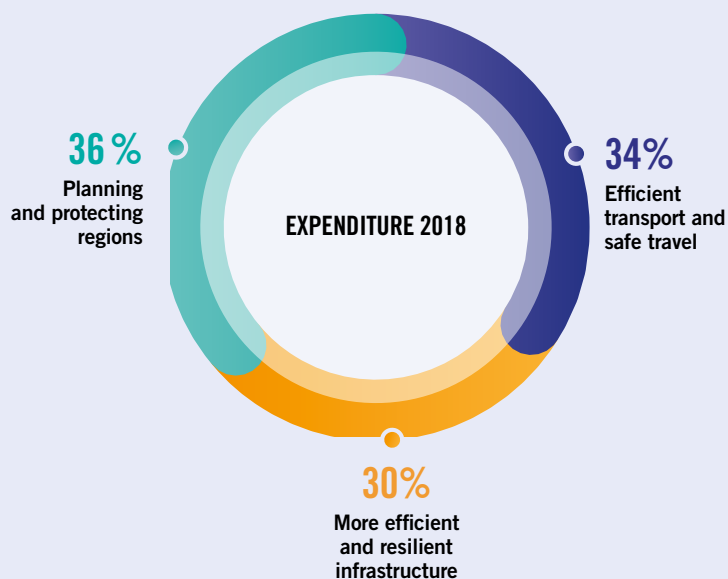
€109,652,250

Total revenue 2018

Proportion of the Institute's internal resources  
and subsidy for public service responsibilities



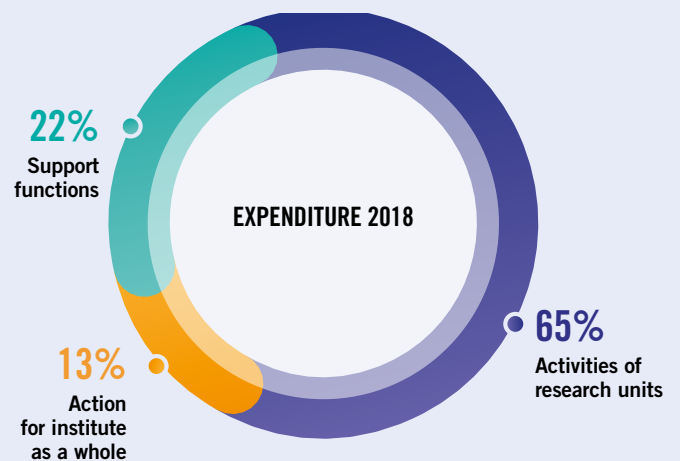
Breakdown of expenditure  
by research theme



€111,118,957

Total expenditure 2018

Breakdown of expenditure  
allocation





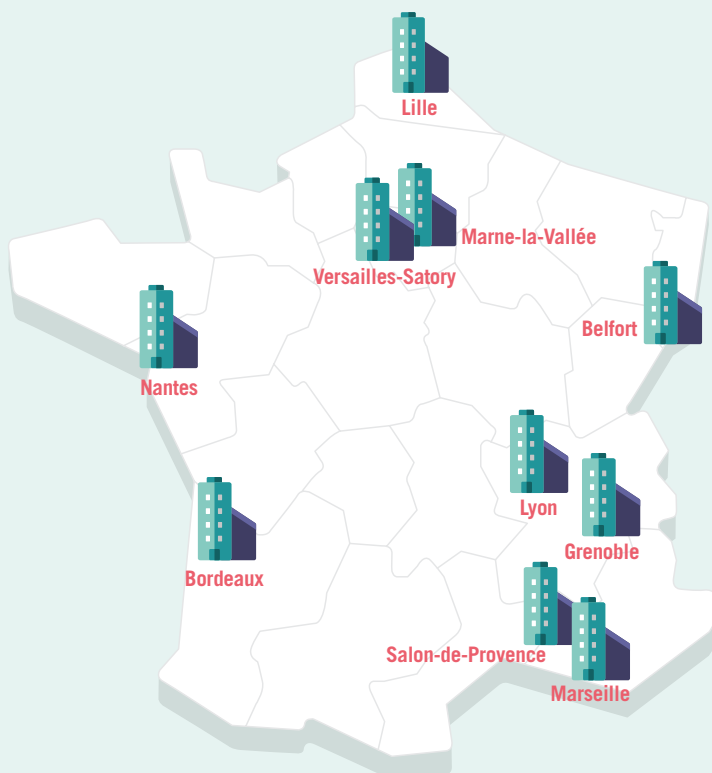


# organisation



# IFSTTAR SITES

## Research Laboratories in France



### Marne-la-Vallée IFSTTAR Headquarters

14-20 Boulevard Newton  
Cité Descartes, Champs-sur-Marne  
F-77447 Marne-la-Vallée Cedex 2  
Tel: +33 (0)1 81 66 80 00

#### Research laboratories:

[CPDM](#), [EMGCU](#), [FM2D](#), [SRO](#), [SV](#), [GRETTIA](#),  
[LEPSIS](#), [LISIS](#), [DEST](#), [LVMT](#), [SPLOTT](#),  
[Simu&Moto](#), [Navier](#)

### Belfort

Fédération FCLAB  
Rue Thierry Mieg  
F-90010 Belfort  
Tel: +33 (0)3 84 58 36 00

#### Research laboratories:

[LTE](#), [TEMA](#), [Fédération FCLAB](#)

### Bordeaux

Cerema DETER Sud-Ouest  
Rue Pierre Ramond - CS 60013  
F-33166 Saint-Médard-en-Jalles Cedex

### Grenoble

Maison des Géosciences  
1381, rue de la Piscine  
F-38400 Saint-Martin-d'Hères

#### Research laboratories:

[ISTerre](#)

### Lille - Villeneuve d'Ascq

20, rue Élisée Reclus  
BP 70317  
F-59666 Villeneuve d'Ascq Cedex  
Tel: +33 (0)3 20 43 83 43

#### Research laboratories:

[ESTAS](#), [LEOST](#)

### Lyon - Bron

25, avenue François Mitterrand  
Case 24  
Cité des mobilités  
F-69675 Bron Cedex  
Tel: +33 (0)4 72 14 23 00

#### Research laboratories:

[RRO](#), [LICIT](#), [LBMC](#), [LESCOT](#), [UMRESTTE](#), [LTE](#),  
[LEPSIS](#), [UMRAE](#)

### Marseille

Faculté de médecine secteur Nord  
Boulevard Pierre Dramard  
F-13916 Marseille Cedex 20  
Tel: +33 (0)4 91 65 80 00

#### Research laboratories:

[LBA](#), [LMA](#)

### Nantes - Bouguenais

Allée des Ponts et Chaussées  
CS 5004  
F-44344 Bouguenais Cedex  
Tel: +33 (0)2 40 84 58 00

#### Research laboratories:

[GéoEND](#), [GMG](#), [MIT](#), [LAMES](#), [GPEM](#), [SMC](#), [EE](#),  
[GEOLOC](#), [MACSI](#), [SII](#), [EASE](#), [UMRAE](#)

### Salon-de-Provence

304, Chemin de la Croix Blanche  
F-13300 Salon de Provence  
Tel: +33 (0)4 90 56 86 30

#### Research laboratories:

[LEPSIS](#), [LMA](#)

### Versailles - Satory

25, Allée des Marronniers  
F-78000 Versailles  
Tel: +33 (0)1 30 84 40 00

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**Christine BOUCHET**

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#### CGT

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- **Nathalie BOTTICCHIO** (deputy member)

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31 DECEMBER 2018



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Vice-Chair  
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#### Unsa

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<a href="#">Allenvi</a> .....	Alliance nationale de recherche pour l'environnement	<a href="#">DGRJ</a> .....	Direction générale de la recherche et de l'innovation
<a href="#">Ancre</a> .....	Alliance nationale de coordination de la recherche pour l'énergie	<a href="#">DLR</a> .....	<i>Deutsches Zentrum für Luft- und Raumfahrt</i> (Centre allemand de recherche pour l'aéronautique et l'astronautique)
<a href="#">Anses</a> .....	Agence nationale de sécurité sanitaire de l'alimentation, de l'environnement et du travail	<a href="#">DOAJ</a> .....	<i>Directory of Open Access Journals</i>
<a href="#">ANR</a> .....	Agence Nationale de la Recherche	<a href="#">Dreal</a> .....	Direction régionale de l'Environnement, de l'Aménagement et du Logement
<a href="#">ARCADI</a> .....	Établissement public de coopération culturelle pour les arts de la scène et de l'image en Île-de-France	<a href="#">DRI</a> .....	Direction de la recherche et de l'Innovation
<a href="#">ARMINES</a> .....	Association pour la recherche et le développement des méthodes et processus industriels	<a href="#">DSR</a> .....	Délégation à la sécurité routière
<a href="#">ARRB</a> .....	<i>Australian Road Research Board</i> (Comité australien de recherche sur les routes)	<a href="#">ECTRI</a> .....	<i>European Conference of Transport Research Institutes</i>
<a href="#">AUGC</a> .....	Association Universitaire de Génie Civil	<a href="#">EDF</a> .....	Électricité de France
<a href="#">BRGM</a> .....	Bureau de recherches géologiques et minières	<a href="#">EIVP</a> .....	École des Ingénieurs de la Ville de Paris
<a href="#">CARA</a> .....	Cluster Auvergne-Rhône-Alpes & pôle de compétitivité	<a href="#">ENPC</a> .....	École nationale des Ponts et Chaussées
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<a href="#">Cerema</a> .....	Centre d'études et d'expertise sur les risques, l'environnement, la mobilité et l'aménagement	<a href="#">Erasmus+</a> .....	Programme de l'Union européenne pour l'éducation, la formation, la jeunesse et le sport pour la période 2014-2020
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<a href="#">CFGJ</a> .....	Comité Français de Géologie de l'Ingénieur et de l'environnement	<a href="#">ESIEE Paris</a> .....	École de l'innovation technologique de la Chambre de commerce et d'industrie de région Paris - Île-de-France
<a href="#">CFMR</a> .....	Comité Français de Mécanique des Roches	<a href="#">ETNA2020</a> .....	<i>European Transport Network Alliance 2020</i>
<a href="#">CFMS</a> .....	Comité Français de Mécanique des Sols et de Géotechnique	<a href="#">FEHRL</a> .....	Forum Européen des Laboratoires Nationaux de Recherche Routière
<a href="#">CIFRE</a> .....	Conventions Industrielles de Formation par la Recherche	<a href="#">FERSI</a> .....	Forum des instituts européens de recherche en sécurité routière
<a href="#">CIRRIS</a> .....	Centre interdisciplinaire de recherche en réadaptation et intégration sociale	<a href="#">FFC</a> .....	Fédération française de carrosserie
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<a href="#">Collex</a> .....	Collections d'Excellence pour la recherche	<a href="#">FWP AF</a> .....	<i>Floating Wind Power Atlantic Forum</i>
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<a href="#">DGITM</a> .....	Direction générale des infrastructures, des transports et de la mer	<a href="#">I2M</a> .....	Institut Mécanique et d'Ingénierie
		<a href="#">IABSE</a> .....	<i>International Association for Bridge and Structural Engineering</i>
		<a href="#">Idrriim</a> .....	Institut des routes, des rues et des infrastructures pour la mobilité
		<a href="#">IFPEN</a> .....	Institut français du pétrole énergies nouvelles
		<a href="#">IRT</a> .....	Institut de recherche technologique
		<a href="#">IFAC</a> .....	<i>International Federation of Automatic Control</i>
		<a href="#">IGN</a> .....	Institut national de l'information géographique et forestière
		<a href="#">i-Lab</a> .....	Dispositif de soutien à la création d'entreprises technologiques innovantes



<a href="#">INDIRA_B</a> .....	<i>INDicators for Reliability and Variability of Bus Systems</i>	<a href="#">Orat</a> .....	Observatoire Rhône-Alpes des Traumatismes
<a href="#">INNOMOB</a> .....	Institut de recherche franco-allemand Innovation for Mobility	<a href="#">PARI</a> .....	<i>Port and Airport Research Institute</i>
<a href="#">INSA</a> .....	Institut National des Sciences Appliquées	<a href="#">PCN Transports</a> ..	Point de contact national Transports
<a href="#">IPIN</a> .....	<i>Indoor positioning and indoor navigation conference</i>	<a href="#">PIA</a> .....	Programme d'investissements d'avenir
<a href="#">IREX</a> .....	Institut pour la recherche appliquée et l'expérimentation en génie civil	<a href="#">PMSI</a> .....	Programme de médicalisation des systèmes d'information
<a href="#">Irstea</a> .....	Institut national de recherche en sciences et technologies pour l'environnement et l'agriculture	<a href="#">PRF</a> .....	Polymère renforcé de fibres
<a href="#">I-SITE</a> .....	Label « Initiatives – Science - Innovation - Territoires - Économie »	<a href="#">PWRI</a> .....	<i>Public Works Research Institute</i>
<a href="#">ISRBT</a> .....	<i>International Seminar on Roads, Bridges &amp; Tunnels</i>	<a href="#">R5G</a> .....	Route de 5 <sup>e</sup> Génération
<a href="#">ITE</a> .....	Infrastructures de transition énergétique	<a href="#">RILEM</a> .....	Réunion Internationale des Laboratoires et Experts des Matériaux, systèmes de construction et ouvrages
<a href="#">ITF</a> .....	<i>International Transport Forum</i>	<a href="#">RIRL</a> .....	Rencontres Internationales de la Recherche en Logistique
<a href="#">ITN</a> .....	<i>Innovation Training Networks</i>	<a href="#">ROA</a> .....	Rencontres Ouvrages d'Art
<a href="#">ITS</a> .....	<i>Intelligent Transportation System</i>	<a href="#">RSNB</a> .....	Rencontres Scientifiques Nationales de Bron
<a href="#">IWSHM</a> .....	<i>International Workshop on Structural Health Monitoring</i>	<a href="#">RSTI</a> .....	Réseau Scientifique et Technique
<a href="#">JEMP</a> .....	Journées d'étude des milieux poreux	<a href="#">RTRI</a> .....	<i>Railway Technical Research Institute</i>
<a href="#">JNGG</a> .....	Journées nationales de géotechnique et de géologie	<a href="#">SNCF</a> .....	Société nationale des chemins de fer français
<a href="#">JTR</a> .....	Journées Techniques Route	<a href="#">SCOOP</a> .....	Projet de déploiement pilote de systèmes de transport intelligents coopératifs
<a href="#">Labex</a> .....	Laboratoire d'excellence	<a href="#">SHS</a> .....	Sciences humaines et sociales
<a href="#">LaPEA</a> .....	Laboratoire de Psychologie et d'Ergonomie Appliquée	<a href="#">SIG3D</a> .....	Système d'information géographique 3D
<a href="#">LIA</a> .....	Laboratoire International Associé	<a href="#">SPI</a> .....	Sciences pour l'Ingénieur
<a href="#">LIQ</a> .....	Laboratoire de recherche en Imagerie et Orthopédie	<a href="#">STAC</a> .....	Service Technique de l'Aviation Civile
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<a href="#">LPG</a> .....	Laboratoire de Planétologie et Géodynamique	<a href="#">T20</a> .....	<i>Think Tanks (T20)</i> dans le cadre du G20
<a href="#">MEGA</a> .....	École Doctorale Mécanique Énergétique Génie civil et Acoustique	<a href="#">TDIE</a> .....	Transport Développement Intermodalité Environnement
<a href="#">MESRI</a> .....	Ministère de l'Enseignement supérieur, de la Recherche et de l'Innovation	<a href="#">TER</a> .....	Transport express régional
<a href="#">Miranda</a> .....	Mesures d'indicateurs routiers par appareils nomades d'auscultation	<a href="#">TRA</a> .....	<i>Transport Research Arena</i>
<a href="#">MPA</a> .....	<i>Materials Testing Institute University of Stuttgart</i>	<a href="#">TRB</a> .....	<i>Transportation Research Board</i>
<a href="#">MTES</a> .....	Ministère de la Transition écologique et solidaire	<a href="#">UMR</a> .....	Unité mixte de recherche
<a href="#">OCDE</a> .....	Organisation de coopération et de développement économiques	<a href="#">UPE</a> .....	Université Paris-Est
<a href="#">OMS</a> .....	Organisation mondiale de la Santé	<a href="#">UPEM</a> .....	Université Paris-Est Marne-la-Vallée
<a href="#">Onema</a> .....	Office national de l'eau et des milieux aquatiques (intégré dans une des directions de l'Agence française de la biodiversité depuis 2016)	<a href="#">URSI</a> .....	Union Radio-Scientifique Internationale
		<a href="#">Vedecom</a> .....	Institut du véhicule décarboné et communicant et de sa mobilité
		<a href="#">VI-DAS</a> .....	<i>Vision Inspired Driver Assistance Systems</i>

An isometric illustration of a winding road on a blue background. The road has a grey surface with white dashed lines. On the road, there is a red double-decker bus, a person on a red bicycle, a red delivery truck, and a person walking a dog. In the sky, there is a satellite, a white cloud, and a red location pin. On the ground, there are green trees, a traffic light, and two people talking. A speech bubble is next to the people talking. The text 'activity report 2018' is written in white in the upper right area of the illustration.

# activity report 2018



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