ESIGELEC

School of engineering

Rouen, Normandy, France

SMART & CONNECTED SYSTEMS

ESIGELEC

École affiliée IMT

enjoy Rouen NORMANDY

1 hour ½ from Paris, 1 hour from the English channel, 2 hours from Belgium

Normandy

ESIGELEC
Rouen
Normandy

PARIS AÉROPORT

ESIGELEC

SYSTÈMES INTELLIGENTS ET CONNECTÉS

Education and Research Higher Institution

In the field of smart and connected systems

ESIGELEC = School of Engineering

IRSEEM = Research Institute

School of Engineering founded in 1901

Recognized by the French State

National label for non-profit HEI of general interest

40% international students, 40 nationalities

400 permanent and part-time faculty and staff

More than 10,000 alumni

Engineering programme : 300 ECTS, mainly taught in French, 1,500 students

Master's programmes : 120 ECTS, 100% in English, 75 students

Doctoral programme : 35 students

IRSEEM: Research Institute

3 research teams : Electronics & systems, Automation & systems, IT & systems

4 technical platforms : Anechoïc chamber, Autonomous navigation, Aircraft pods, vehicles test bench

80 partner universities in **42** countries

SMART & CONNECTED SYSTEMS

ESIGELEC

École affiliée IMT

Fields of studies

ELECTRONICS & ELECTRICAL ENGINEERING

- Electronic for Automotive and Aeronautics Systems
- Automation and Industrial Robotics
- Electrical Engineering and Transport
- Mechatronics and Electrical Engineering
- Embedded Systems Engineering, Autonomous Vehicles
- Embedded Systems Engineering, Communicating Objects
- Energy and Sustainable Development
- Medical Engineering
- Electronic Embedded Systems ⇨ master in English

INFORMATION TECHNOLOGIES

- Communications Engineering
- Networks Architecture and Security
- Digital Services Engineering
- Big Data for Digital Transformation
- Information systems ⇨ master in English

BUSINESS AND FINANCE ENGINEERING

- Business Engineer, Networks and Telecommunications
- Business Engineer, Energy and Signals
- Finance Engineer

companies

A network of 3000 companies, including:

ESIGELEC

Research institute

Institute of Research in Embedded Electronic Systems

irseem

Common Research Field : « Cyber-physical systems in severe environments »

3 research teams :

I. **Electronics & Systems (ES):** Electromagnetism, EMC, Microwaves and Reliability
II. **Automatic Control & Systems (AS):** Motor Diagnosis and Control, Complex Systems Monitoring
III. **Instrumentation, Data Processing & Systems (IIS):** navigation, autonomous navigation

ESIGELEC

UNIVERSITÉ DE ROUEN NORMANDIE

INSTITUT CARNOT ESP

Research institute

Institute of Research in Embedded Electronic Systems

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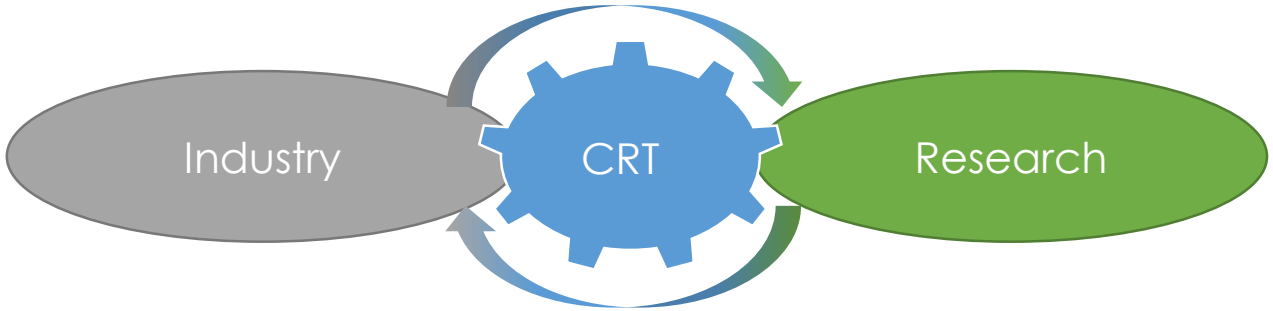
Technology Transfer Center for :

- Automotive
- Aeronautics
- Electronics
- Energy
- Telecommunication
- Health
- transportation, logistics, security



ESIGELEC

UNIVERSITÉ DE ROUEN NORMANDIE

INSTITUT CARNOT ESP

1

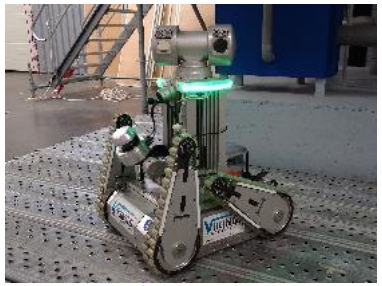
ES TEAM : Electronics & Systems

Research and Developpement @IRSEEM





AUTONOMOUS NAVIGATION





SIGNAL INTEGRITY, ANTENNAS, RELIABILITY, …

PLATFORMS + 35 PhD, Engineers and Technicians Dedicated Staff

AIRCRAFT ENGINE NACELLE

VEHICLE TESTING



Electronics & Systems

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Context

- Development of complete simulation approach of EMC phenomena (including Signal Integrity and Antennas) of complex systems (Approach Bottom-Up)

- Reduction of Risks Related to the use of New Technologies (Specific ageing tests, Modeling, Failure analysis …)

Electronic and Systems

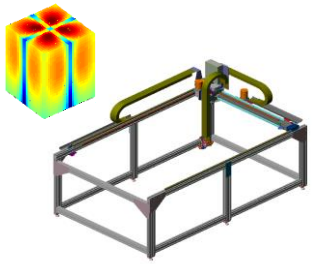
irseem

Team members

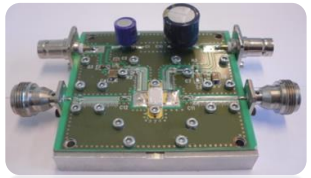
- 9 Associate Professors (4 HDR)
- 1 Post-Doctoral fellow
- 12 on going PhD

Application Domains

- Automotive
- Aeronautic
- Energy
- Microelectronic




EMC of Components and Systems :

- EMC Characterisation
- EMC Modeling and simulation
- SI Modeling

Reliability of Component and Systems :

- Ageing Tests (thermal, Electromagnetic, Electric, …)
- Modeling and failure analysis

Electronic and Systems

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Examples of covered EMC Topics

- Near Field Characterisation and modeling of Radiated Emission (RE)
- EMC filters design
- Conducted Immunity characterisation and modeling of Integrated Circuits (IC)
- Radiated Immunity of Embedded Systems
- EMC Modeling of DC/DC Power converter an DC motors
- Signal Integrity Modeling of Multilayers PCB
- …

Automotive Applications

- PCB, Integrated Circuits, Cables, Shielding, wireless charging,…
- Impact of temperature on EMC filter behaviour
- CAN Transceivers, Voltage Regulator, Microcontrollers, …
- Lighting system in automotive, smart systems, …
- Power Converter, Air conditioning systems, seating motors,
- Embedded camera, …
- …

Electronic and Systems

irseem

Examples of covered Reliability Topics

- Thermal and electrical ageing tests*
- Electromagnetics Robustness tests and modeling
- Transient electrical robustness tests (ESD*, EOS, …)
- Cyclic Short-Circuit test on Power Transistors (SiC, GaN, …)
- …

Automotive Applications

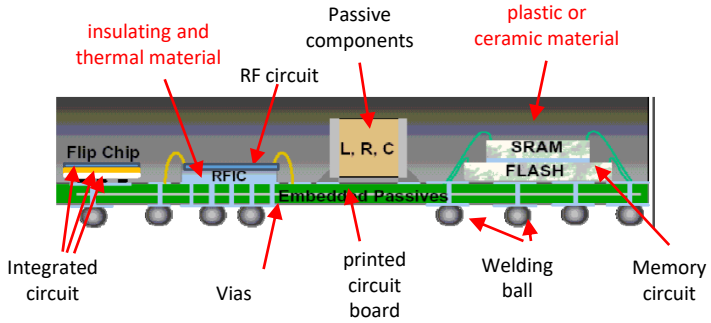
- DC/DC Converters, capacitors, sensors, …
- ECU, CAN Transceivers, smart systems, …
- Integrated Circuits, Actuators, Transistors, Smart electronics, …
- Power transistors, …
- …

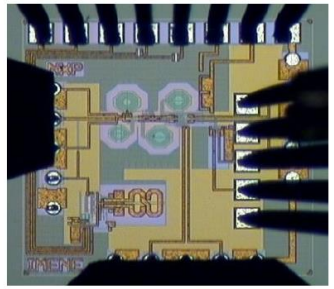
Topics Covered by Design, Characterization, Modeling and Materials for mmWave RF Applications

- **Circuits and Systems technologies**:
  - Antenna
  - Microwave to mmWave active antennas
  - RF and mmWave design
  - New adaptable materials
  - Design of advanced circuits including microwave test solutions (DFT/BIST)
- **Systems integration**
  - Chip-Package and PCB co-design : simulation and optimization of packagings
  - Modeling Parasitic Effects within a Broadband Test Circuit
  - Co-design antenna-circuit-packaging interconnects-substrate
  - 3D packaging for integrated circuits and systems
  - Assembly and encapsulation technologies
  - RF electromagnetics Interactions and interconnections in System-in-Package.
- **Autonomous radio system**
  - Low energy consumption and autonomous energy concepts
- **Methods of characterization and tests**
  - Wideband electrical characterization of new materials and impact for RF applications.
  - Millimeter wave characterization
  - Packaging Design & Characterization

Electronic and Systems

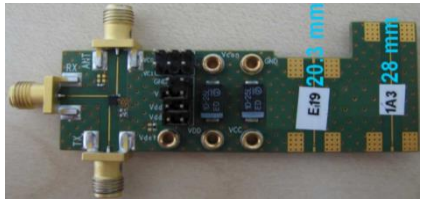
Examples of Applications



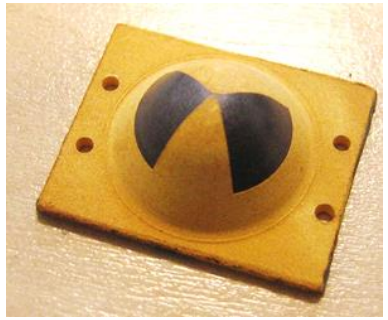


Example of IC including microwave test solutions

Evaluation board

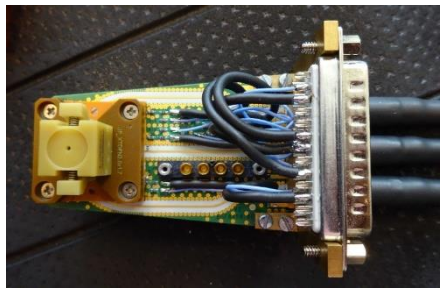


Development of an Efficient Methodolgy for Modeling Parasitic Effects within a Broadband Test Circuit



3D antenna for 5G communications

Test board with a socket



Electronic and Systems

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Industrial partners :

RENAULT La vie avec passion

PSA GROUPE

faurecia

Valeo

SAFRAN

FEDERAL MOGUL

NXP

THALES

PRESTO Engineering

Institutional & academics French partners :

GPM Groupe de Physique des Matériaux

GeePS Génie électrique et électronique de Paris

IMEP-LAHC

IFSTTAR

SATIE

Ampère

UMR 6614 CORIA COMPLEXE DE RECHERCHE INTERPROFESSIONNEL EN AEROTHERMOCHIMIE

GREAH

RISM

Academics partners abroad :

Université Libanaise

ENISo École Nationale d'Ingénieurs de Sousse

Université de Tlemcen

UCL Université catholique de Louvain

Electronic and Systems

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On going projects

- SURFAS (INTERREG V-A) (http://surfas-project.eu/) : Rectennas, Reflecting Surfaces, Communicating devices, …
- EDEMA (Europe) : Signal Integrity on embedded camera (modelling of multilayer PCBs, EMC investigations…)
- VATHIVAC (CARNOT ESP) : Reliability and robustness of aeromantic high power connectors
- Chaire FAURECIA : Mechatronics systems (composite materials, Shielding effectiveness, …)
- PREDIRE (Normandie Region) : Command and control of Energy systems
- ANDECE (Normandie Region) : Diagnostic of failures on Power modules
- EMOCAVI (Normandie Region) : Reliability and Robustenne of GaN Power Transistor
- FIL Harmonique (Normandie Region) : microenergy harvesting

RESEARCH @ IRSEEM

2

AS TEAM : Automatic Control & Systems

Research and Developpement @IRSEEM

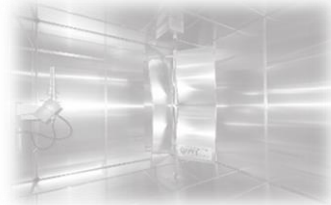




AUTONOMOUS NAVIGATION



SIGNAL INTEGRITY, ANTENNAS, RELIABILITY, …



PLATFORMS
+
35 PhD, Engineers and Technicians Dedicated Staff

AIRCRAFT ENGINE NACELLE

VEHICLE TESTING



Automatic Control and Systems

irseem

Context

- Performance optimization under constraints (technology, cost, environment, …)

- Increasing number of embedded control functions

Automatic Control and Systems

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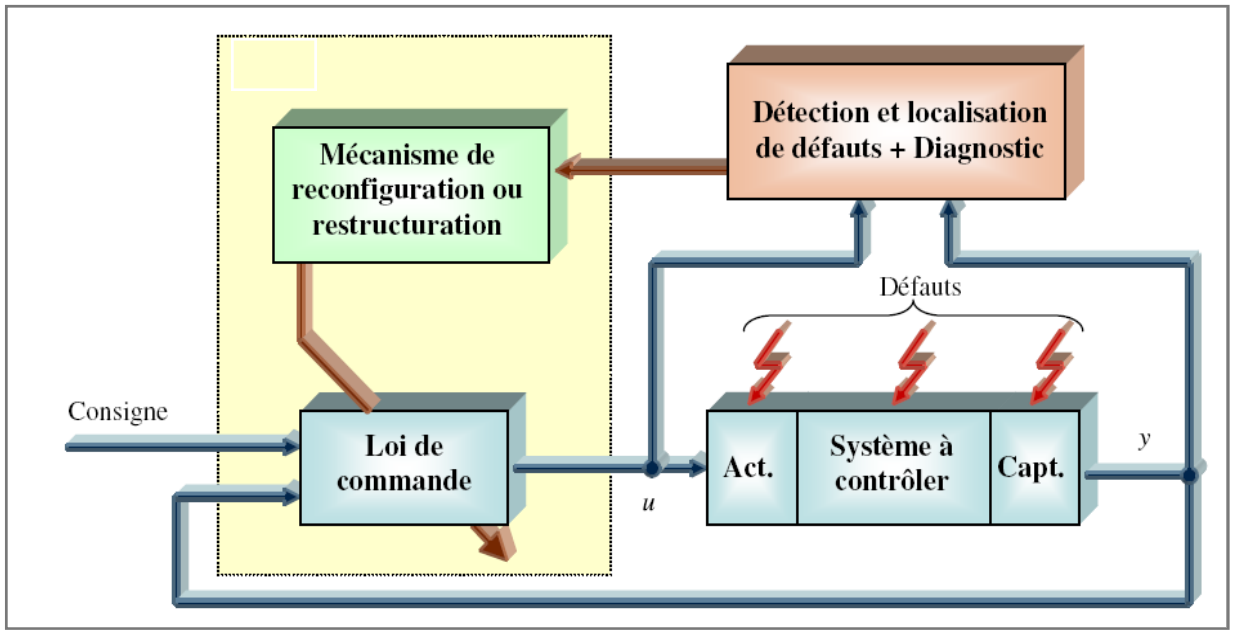
Team members:

- 4 Dr. “HDR”
- 2 Dr.
- 15 PhD students co-supervised
  - including 5 with companies
  - Including 8 with labs abroad

Fault Tolerant Control (FTC) :



Fields of investigations:

- Diagnosis / Prognostic (system, actuator and sensor reliability)
- Regulation / trajectory tracking in nominal and faulty operating cases (energy management)
- System state and model parameters estimation

Automatic Control and Systems

irseem

Transportation Systems

- Engine air path (control / diagnosis)
- Exhaust system
- Battery (health monitoring)
- Motor (diagnosis / energy management)
- Motorway toll
- Sea port

Food-processing Industry

- Distillation unit (control)

Aeronautics / Space

- Quad Tilt Wing convertible drones (control)
- Nacelle reverse system
- Aircraft wing de-icing system
- Reusable rocket engine

Energy

- Wind turbine (diagnosis / prognostic)
- Smart grid (control)

Automatic Control and Systems

irseem

Industrial partners :

arianeGROUP

faurecia

SAFRAN

sanef

SEGULA TECHNOLOGIES

SIT ASPi SBMT BERRE LE NERRANT

PSA GROUPE

ZODIAC AEROSPACE

Institutional & academics French partners :

UMR 6614 CORIA COMPLEXE DE RECHERCHE INTERPROFESSIONNEL EN AEROTHERMOCHIMIE

litis

LOFTMS

GREAH

LMAH

ONERA THE FRENCH AEROSPACE LAB

cnes CENTRE NATIONAL D'ÉTUDES SPATIALES

Academics partners abroad :

LASYS

ACSE automatic control and systems engineering

LARATSI

LARA LR Automatique

L.S.E.I Laboratoire des Systèmes Electriques et Industriels

PERE

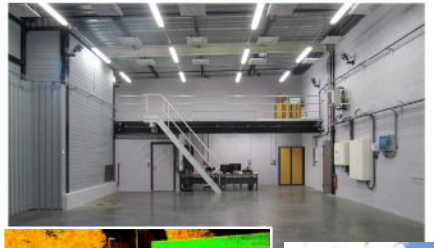
UTSA

RESEARCH @ IRSEEM

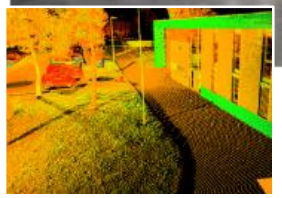
3

IIS TEAM : Instrumentation, data processing & Systems

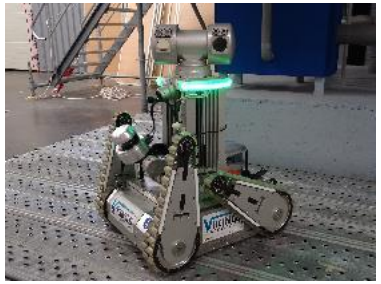
Research and Developpement @IRSEEM








AUTONOMOUS NAVIGATION





ELECTROMAGNETIC COMPATIBILITY

PLATFORMS + 35 PhD, Engineers and Technicians Dedicated Staff

AIRCRAFT ENGINE NACELLE

VEHICLE TESTING



RESEARCH @ IIS TEAM

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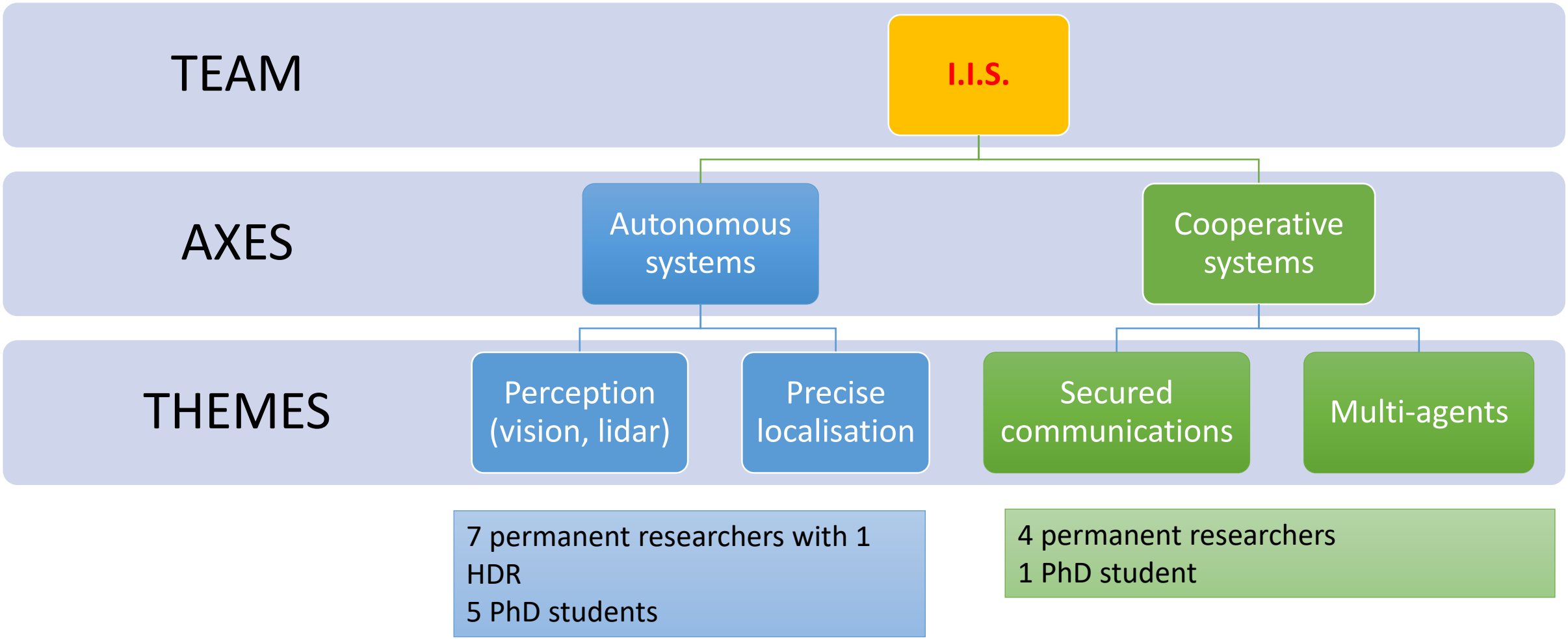

RESEARCH @ IIS TEAM

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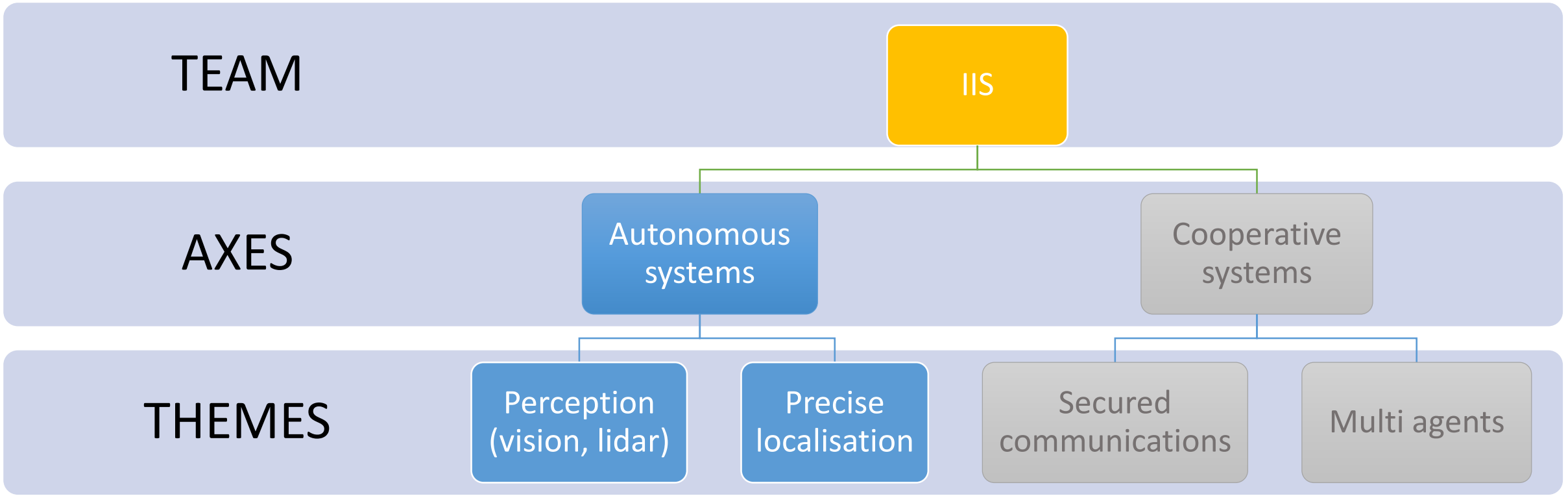

AUTONOMOUS DRIVING (AD) SYSTEM

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GPS
IMS

Pose estimation

CAMERAS

Object detection

Localisation

Maps
(prior knowledge)

3D SCANNER
LIDARS

Localisation

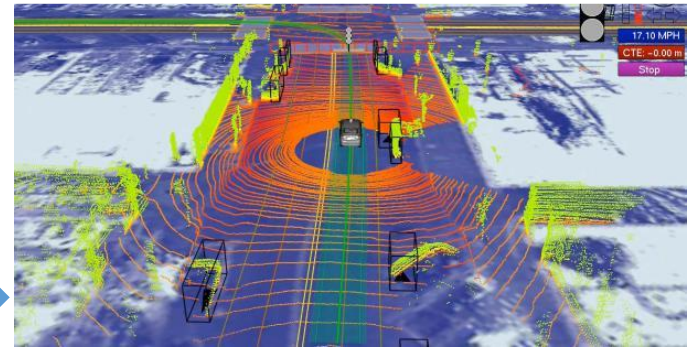
Maps
(prior knowledge)

Object detection

RADARS

Object detection

Data fusion in common 3D maps

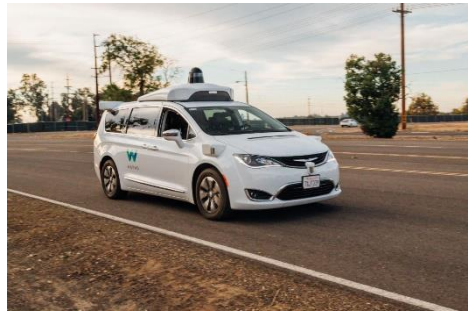


LOCAL PLANNING

LONGITUDINAL / LATERAL CONTROL

GLOBAL PLANNING

SUPERVISION



RESEARCH @ IIS TEAM

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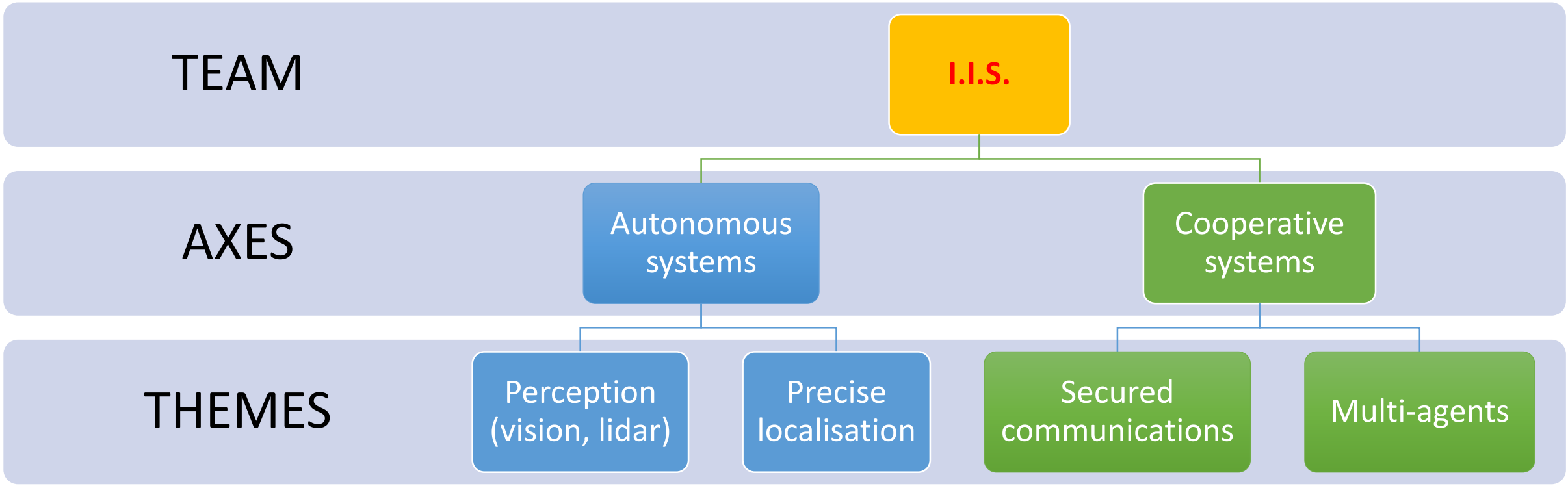

RESEARCH @ IIS TEAM

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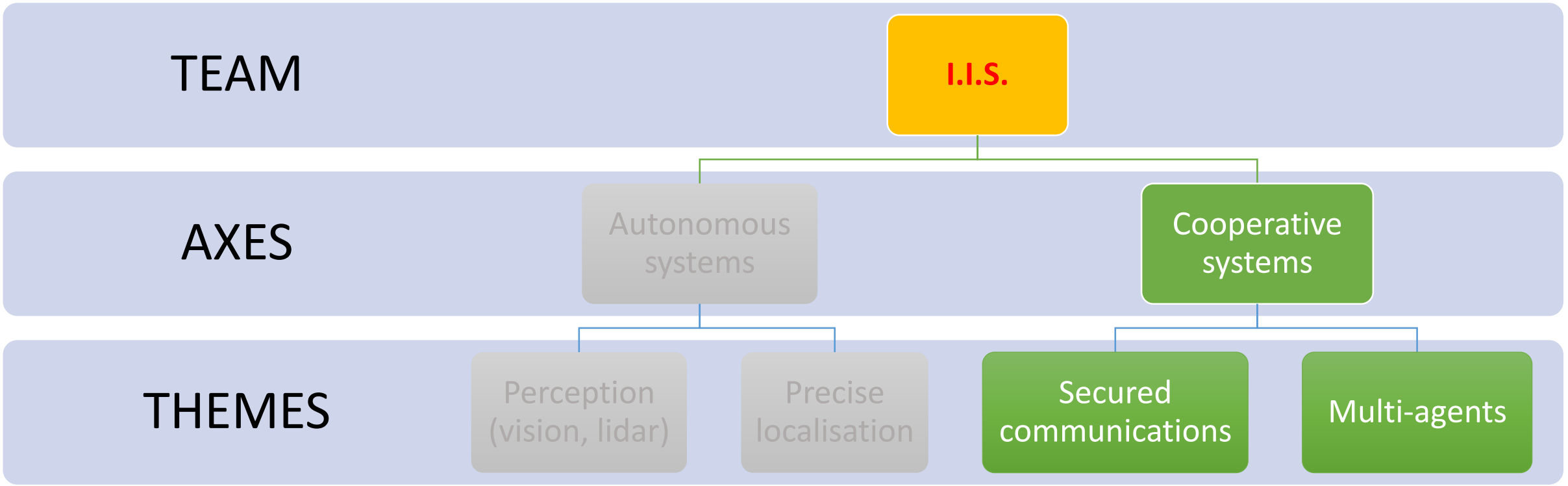
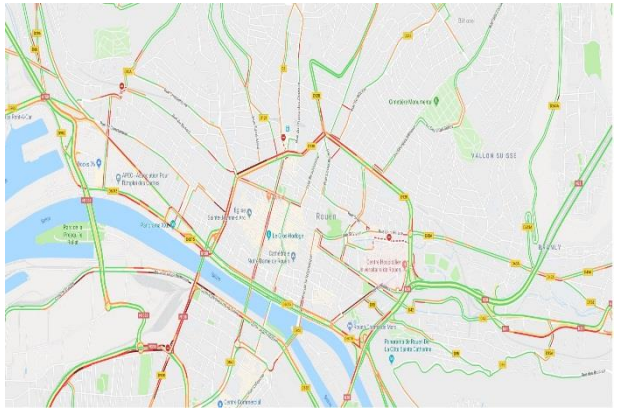
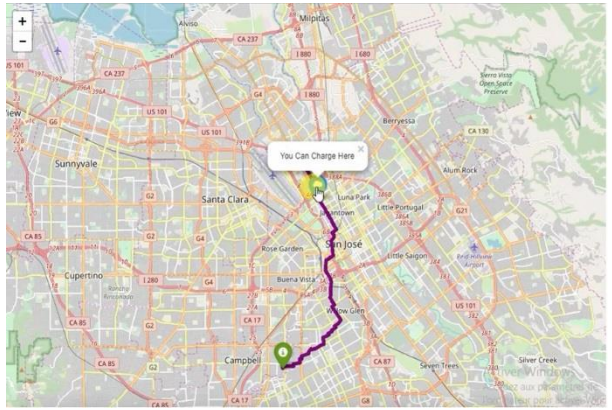




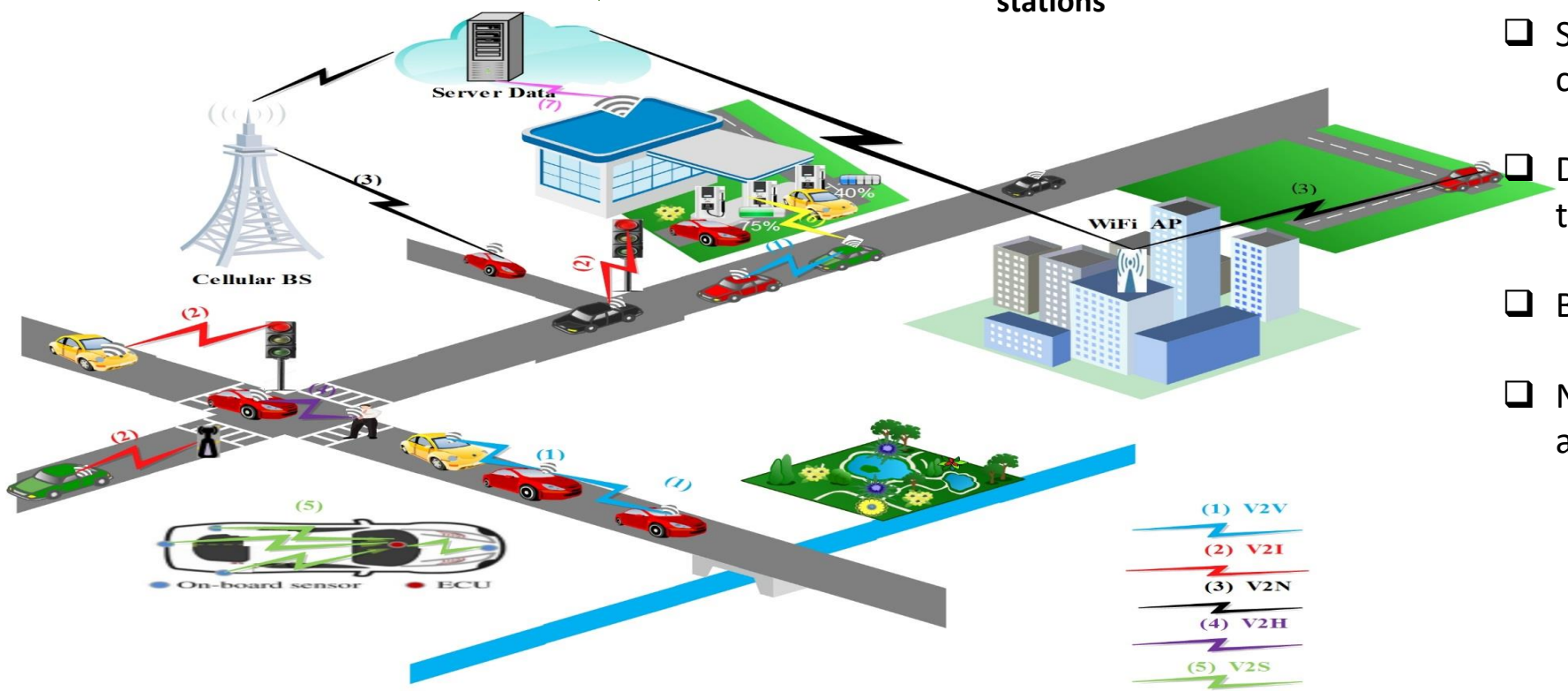
Real-time energy map

Service 1

Service 2



Optimal way through recharging stations



Plateforme Urbaine pour des Véhicules Electriques Connectés (PUVEC)

- ❑ Realistic trafic simulation platform (SUMO)
- ❑ Secured communications
- ❑ Data verification using trust-based approaches
- ❑ Big data
- ❑ New services for clean and smart mobility

ESIGELEC

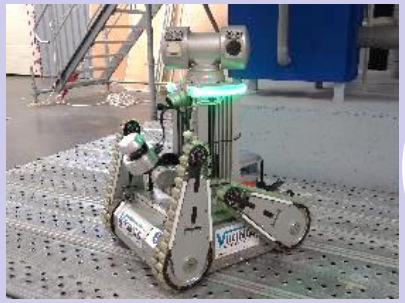
Projet hubert-curien Franco-Tunisien 2016-2019

CAMPUS FRANCE campusfrance.org

Perception for autonomous vehicles

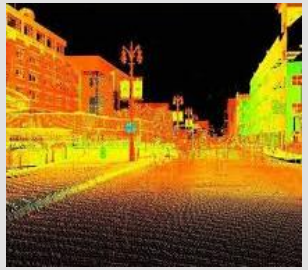
Some examples:

- Autonomous robot for offshore platforms inspection (**ARGOS** Challenge with **TOTAL**)
- 3D LIDAR detection & tracking (**PSA**)
- Autonomous wheel chair (INTERREG **ADAPT**)
- 3D precise localisation for autonomous vehicle (**TRANSDEV**)



Facilities

- 3D motion capture room (VICON 20 camera + transportable BONITA 5 cameras)
- 3D scan station (LEICA C10)
- Instrumented vehicle (GPS-RTK, Velodyne HDL 64)



SCOPE AND ISSUES

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AUTONOMOUS AND COOPERATIVE SYSTEMS (ROBOTS, VEHICLES)

Automotive

Transports

Health

Indutry

Autonomous Navigation The machine has to **Perceive**, **Analyze** and **Decide** in real time

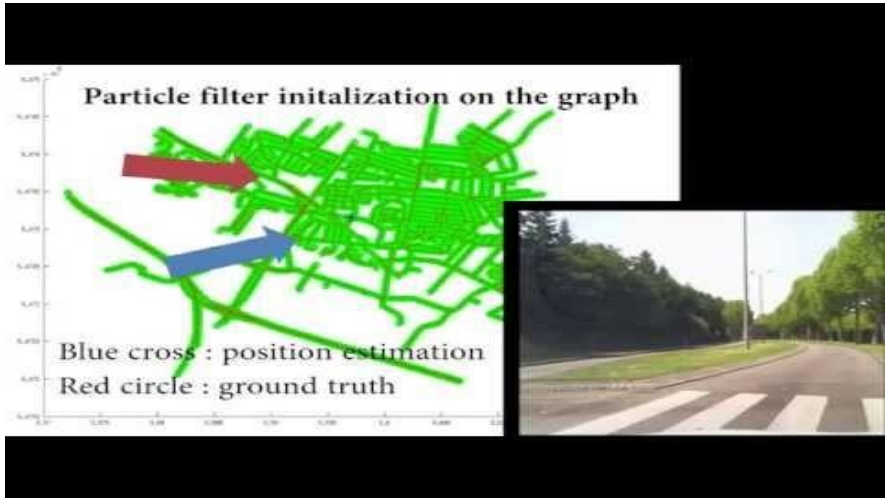
Perception layer **Position** (localization), **velocity** (odometry), **obstacles** (surrounding environment)

Cooperative systems: **Sharing** and **fusion** of **data** between systems using **wireless communications**

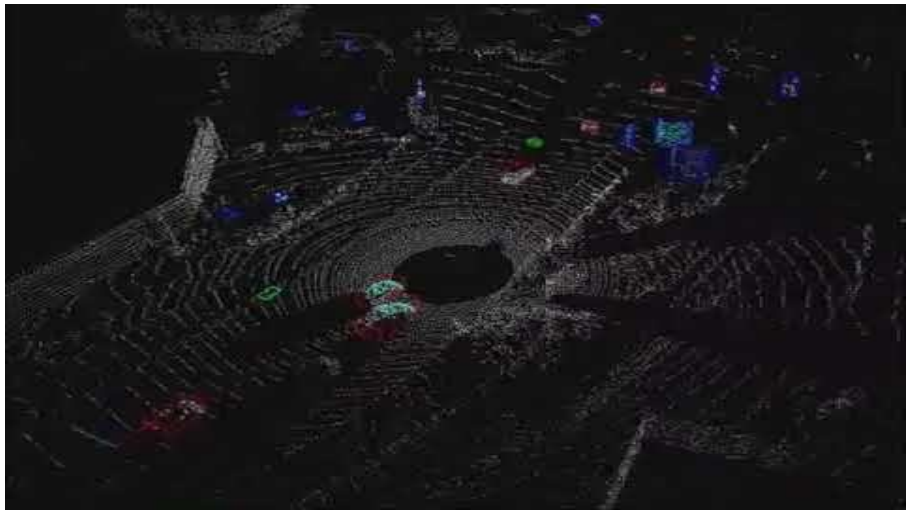
SOME VIDEO EXAMPLES

irseem

Bayesian filtering for vehicle positionning when no GPS



3D LIDAR for mobile mapping and precise localisation



Autonomous robotics

Simulation

Mainly turned toward industrial cooperations

SMEs

Ets Jaunet
INTEMPORA
FAAR industry
FACTEM
ACKSYS COMMUNICATIONS & SYSTEMS
Advanten
celec
JACQUES DUBOIS
SYNCHRONIC
FILTRATION TECHNOLOGY Verlab above
IER
davey bickford

International Firms

transdev
AREVA
BOUYGUES ENERGIES & SERVICES
BlueSolutions
THALES
PSA PEUGEOT CITROËN
RENAULT
Valeo
faurecia
ACOME
SAFRAN
StanleyBlack&Decker
Schneider Electric
TOTAL
LEONI
molex
FEDERAL MOGUL

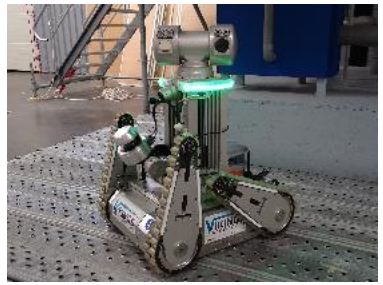
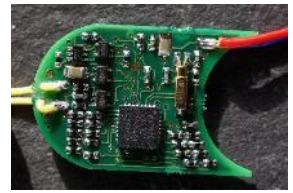
Labs

CentraleSupélec
UHA Université de Haute-Alsace Mulhouse-Colmar
CHU Hôpitaux de Rouen
ETAPS
IFSTTAR
Groupe INTRA







Thank you !

international@esigelec.fr
www.esigelec.fr

SYSTÈMES INTELLIGENTS ET CONNECTÉS

ESIGELEC