CNRS - INP - UT3 - UT1 - UT2J

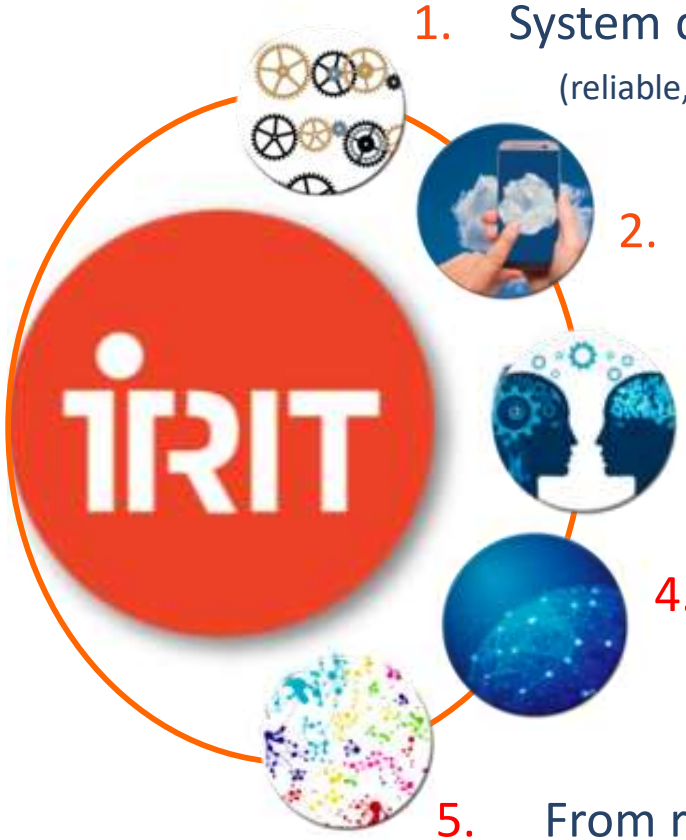
Institut de Recherche en Informatique de Toulouse

Informatics Research Institute of Toulouse

Research at IRIT

Mankind and its environment
at the heart of computer science

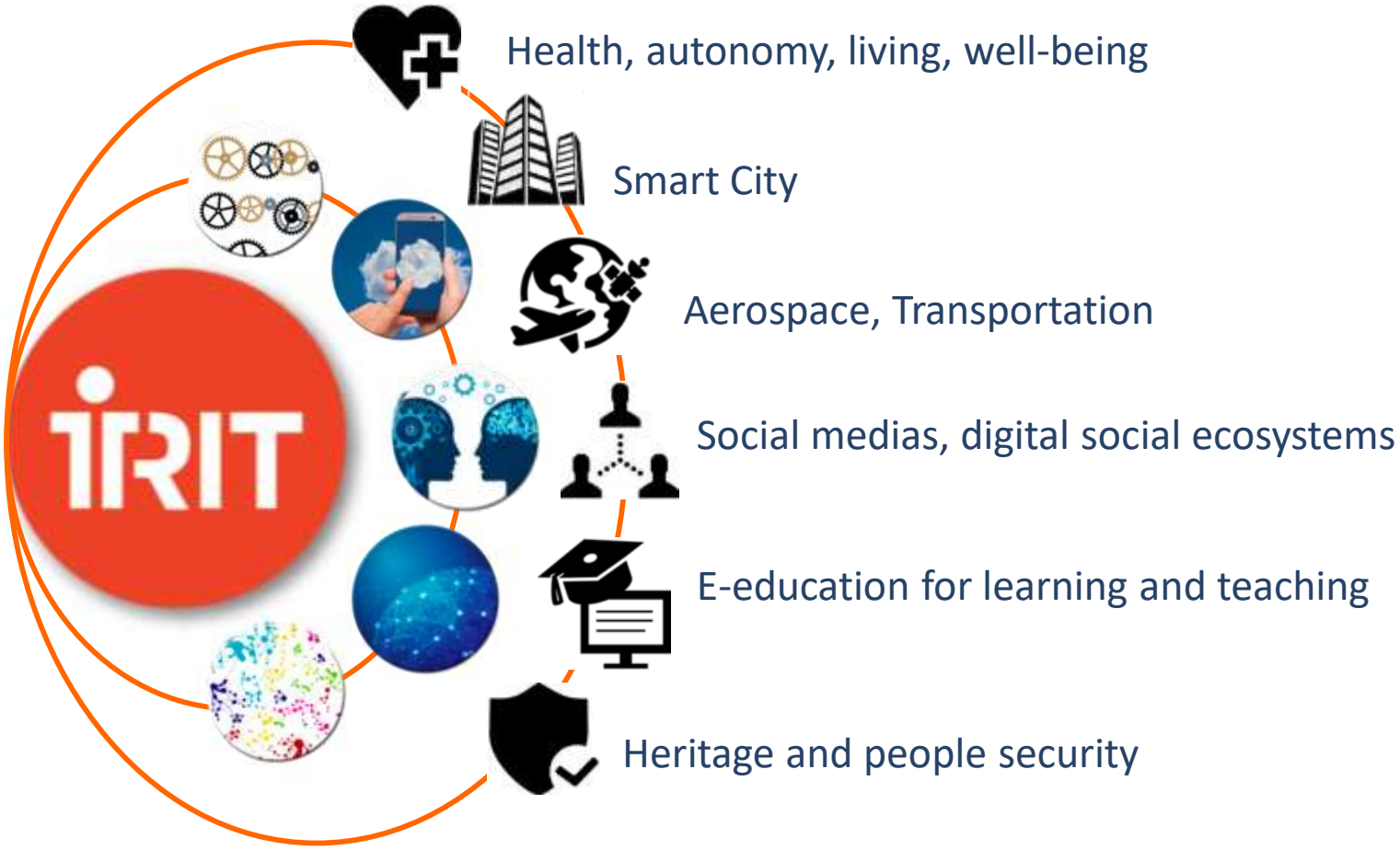
Major scientific issues



1. System design and construction
   (reliable, safe, adaptative, distributed, interconnected, dynamic…)
2. Real-world digital modeling
3. Concept formalization for cognition and interaction
4. Toward environment-aware adaptative autonomous systems
5. From raw data to intelligible information

Strategical application areas

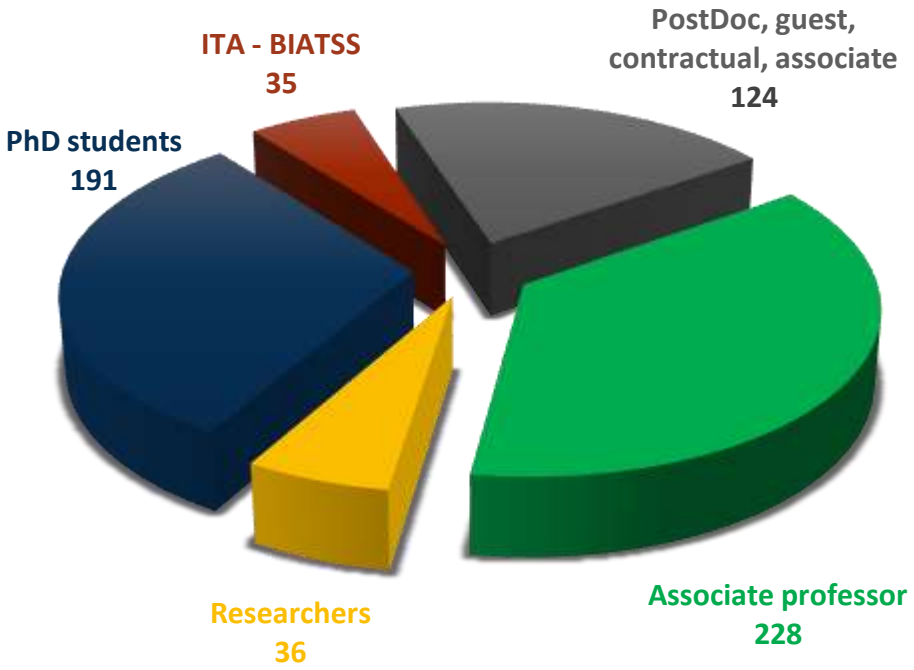
… related to societal challenges



… and strategic action Scientific Computing, big Data and AI

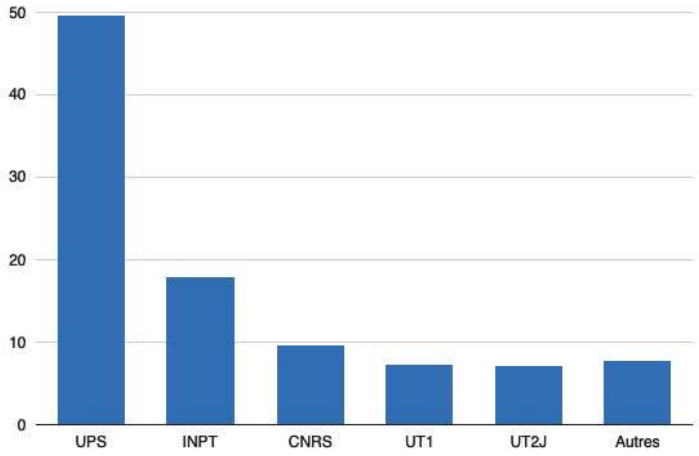
Organization of research at IRIT

~ 600 members, permanents and non-permanent



Number of members by category

Percentage of members by establishment



Workforce as of 09/2021

Un laboratoire multi-tutelles et multi-sites

A Research Unit (UMR)

cnrs

INP

UNIVERSITÉ TOULOUSE III PAUL SABATIER

Université de Toulouse

UNIVERSITÉ TOULOUSE 1 CAPITOLE

UNIVERSITÉ TOULOUSE Jean Jaurès

7 locations in Occitania

7 DEPARTMENTS & 25 RESEARCH TEAMS

Signals and Images
MINDS
TCI
SC
SAMoVA
STORM

Data Management
IRIS
PYRAMIDE
SIG

Interaction, Collective Intelligence
ELIPSE
TALENT
SMAC

Reliability of Systems and Software
ICS
SM@RT
ACADIE
ARGOS

Artificial Intelligence
ADRIA
LILaC
MELODI

Architecture, Systems Networks
RMESS
TRACES
T2RS
SIERA
SEPIA

HPC, Simulation Optimization
REVA
APO

Partnerships and Transfer

Agreements

- LACII (avec le CESDV – IJA)
- HAND'INNOV (avec l'ASEI)
- Accord cadre avec l'ENSP

Transfer and IP

- 8 APP deposits
- 7 patents
- 10 contracts of transfert signed
- TTT has invested 1297 k€ at IRIT since its beginning

- **29 PHD funded under CIFRE (january-2018)**
- **Participation in 6 IRT Saint Exupéry projects**
- **LABEX CIMI**

Platforms

For experiments and increased visibility of our research :

- **OSIRIM: for information retrieval :**
  - 1 PB, 640 cores + 24 GPUs Nvidia 1080TI
  - Big Data software environnement: Spark, MongoDB,Hadoop, …
  - 1 IR + 1 IE
- **CloudMip / GRID5000 / GridMip : cloud / grid platforms**
- **neOCampus : smart campus**
  - Equipment of 3 lectures rooms with sensors
- **Connected Health Lab for e-Health in Castres**

Scientific Issues

System Design and Construction

Design and construction of reliable, safe, adaptative, distributed, interconnected, dynamic, … systems

- **Development process**
  - Model engineering and certification
  - Composition of analysis
- **Integration of the increasing complexity of new systems**
  - Managing heterogeneity of the open character of systems
- **Taking into account system constraints**
  - Argued compromise (reliability, usability, safety, dependability, performance, security, cost…)
- **Reliability of systems**
  - Promotion of the use of formal methods
  - Adaptive monitoring

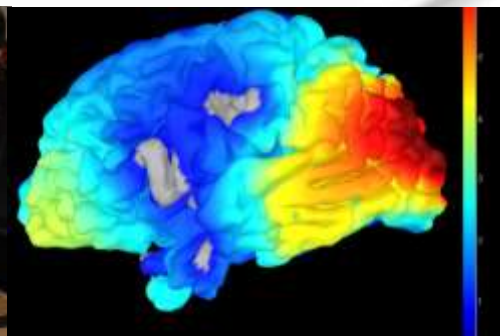
Real-world digital modeling

- **Representation :** sparsity-based sampling, large scale, integration of multi-sources and multi-scales data
- **Processing :** analysis and fusion of complex multi-varied and/or hetergeneous data
- **Simulations :** taking into account large scale, heterogeneity, indetemination and precision control

Concept formalization for cognition and interaction

- Definition of unified formalisms for cognition and interaction
- New paradigms for multi-dimensional interaction
- Natural interaction in degraded situation



Toward environment-aware adaptative autonomous systems

- **Organization of distributed/interconnected/dynamic systems**
  - Optimization, evolution, learning and management of resources
  - Taking into account heterogeneity and scaling

- **Complex systems**
  - Theory of systems : structures of groups, opinion diffusion
  - Study of convergence, stability, robustness, resilience, self-* properties

- **Engineering of sociotechnical systems**
  - Modelling of the entity up to the system and its environment
  - Design of collectives of systems

neOCampus

From raw data to intelligible information

- **Large scale representation of data and knowledge**
  - Integration of heterogeneous information (visual, textual…)
- **Multifactorial access to data**
  - Taking into account simultaneously volume and velocity
  - Taking into account by various factors of relevance (content, user, context)
- **Generation of understandable information**
  - Aggregation/synthesis of information
  - Reasoning on inconsistent and uncertain data
  - Knowledge extraction from data : synergy between symbolic and statistical approaches
  - Various approaches for machine-learning

Strategical applications areas and Societal Challenges

Health, autonomy, living, well-being

- **Predictive and precise medecine**
  - Connected health
  - Personalized care plan
  - Participatory health forum
- **Digital for Silver Economy**
  - Human-robot interaction and connected environments
  - Accessibles ICT for seniors
  - Assistance predictive technologies
- **Handicaps : an Inclusive and participative digital society**
  - Digital technology accessible as factor of inclusion
  - Accessibility of Open Data
  - Understanding space without vision
- **Cancer and chronic diseases: from the diagnosis to the therapy**
  - Multi-modal and multi-scale Imaging
  - Autoamatic discovery of treatments
  - Epidemiology by extraction of knowledge

Smart City

- **Energy transition**
  - Piloting of networks (energetic mix) smart grid
  - Management of energy efficiency in a building: visualization, control and automatization
  - Singularity and amlfunction detection
- **Quality of life (services, comfort, health), eco-responsible citizen**
  - Detection and learning of behavior of users and devices
  - Autonomy and auto-adaptation of systems to their socio-technical environment
  - Management of the users well-being in the urban area
- **Mobility, multi-modal transports**
  - Simulation of the dynamics of urban travels
  - Geo-localization and synchronization of connected objects
  - Optimization of communications and flows (pedestrians, vehicles, fluids, …)

- **Resources:** AMILAB platform, neOCampus server, neoCampusLabs, CloudMIP, Osirim, 9 research teams, 29 ongoing PhD
- **Activity; Projects :** 15 projects + 4 submitted, 19 industrial partners

Aerospace and transportation

- **Advanced communications by satellites**
  - Internet for all
  - Seamless Internet
- **Safety and security of planes and drones**
  - User-centered interactive systems
  - Critical systems and software
  - Security of ground-to-air and air-to-air communications
- **Earth observation**
  - Models and methods for using geospatial data
  - Processinf and analysis of satellite and airborne image
  - Monitoring and evolution critical infrastructures and eco-systemic services

Social medias, digital social ecosystems

- **Analysis of dynamicity of social networks**
  - Community detection
  - Diffusion of information: controversy, buzzes, spam, crowd sourcing
  - Role detection (social influence, authority, propaganda,etc.)

- **Content analysis**
  - Opinion-mining: feelings, intentions, points of view, …
  - Identification of marginal behaviors (weak signals)

- **Coordination by networks**
  - Crisis management (alert, resoures organization)
  - Group decision and vote

E-education for learning and teaching

- **Strategies and tools to welcome an increasing mass of learners**
  - Social interactions for learning
  - Ludification of learning systems
  - Large scale management (MOOCS, etc)

- **Personalization of adaptation of learning environments**
  - Adaptative learning
  - Accessibility of pedagogical resources (visual handicap)

- **E-training all along the life**
  - Training path based on skills; adequacy with the jobs
  - Distance learning

Heritage and people safety

- **From IT security**
  - Cryptography, protection of personal data, security and multimedia data, network and infrastructure security, security of software systems, security of hardware systems
- **…Up to cybersecurity**
  - Identify the vulnerabilities and the threats
  - Protect people and goods
  - Crisis management

IRIT: a key player in the digital world

- SFR-AEF

École supérieure du professorat et de l'éducation Académie de Toulouse

Université de Toulouse

- Labcoms (Joint SME laboratories)

CHERCHONS POUR VOIR

ALICIA VISION

- 1 Carnot institute

institut cognition

CRCT

Shared team

cimi TOULOUSE

IMT, IRIT, LAAS

IRT SAINT EXUPERY

IRIT : a key player in the digital world

Ability to tackle societal/economic challenges within the framework of local/regional/national/international cooperations :

- **Health : autonomy/e-health**
  - Handicap : partnership with A.S.E.I (Hand'innov joint Lab)
  - Institute of young blind people (LACII joint Lab)
  - PRESTO partnership (French Sign Language)
  - Involvement en CENTISH (CNRS, Mutualité Française…)
  - ITAV
- **Embedded systems : AIRSYS joint Lab, St Exupéry IRT**
- **Smart campus project at Paul Sabatier University**

Ability to cover all aspects of nowadays challenges such as Big Data, Internet of Things, security…

Links with socioeconomic world

Technological transfer :

- **Industry – IRIT** meetings with other local partners (MPI, poles of competitiveness, CRCI, SATT TTT, Mêlée Numérique, CUSI, Syntec Informatique…)
- **Involvement in poles of competitiveness:** Aerospace Valley, Cancer Bio Santé and Agri-Sud-Ouest Innovation), cluster Digital Place
- **Collaborations with SMEs and startups** (FittingBox, Devatics, Instinct Maker, Onesia, Upetec and Digiteyezer).

International : main cooperations

Armenia : through two ERASMUS+, several INTAS projects, ISTC, bilateral programs, FP7 ERAWIDE project, two MOUs between the National Academy of Sciences of the Republic of Armenia, the French University in Armenia and IRIT supervisors.

Australia : A framework agreement was signed in March 2019 with the University of Wollongong in Australia with an ongoing project on vehicle traffic simulation.

Brazil : IRIT leads the GDRI "Web Sciences

Cuba : An agreement is being signed with the "Universidad de las Ciencias Informáticas (UCI)" in Cuba.

Japan : with several formalized cooperations: agreements with the National Institute of Informatics renewed several times and still active (decision support, formal logic, computing, data science,...), cooperations with the universities of Tokyo and Tsukuba as well as Riken.Madagascar : Erasmus +

Africa and Madagascar : IRIT is developing cooperation activities (support for doctoral training, masters, implementation of the LMD) and bilateral projects (PHC, PICS, etc.) with several countries in the Maghreb, sub-Saharan and equatorial Africa.
Cooperation agreements have been signed by our supervisors with Cameroon and Madagascar.

Singapore : with a cooperation around image and multimedia which is translated by an association with the international CNRS mixed unit IPAL (Image and Pervasive Access Lab) whose new director is a CNRS - IRIT Research Director.

United States : with a cooperation around high performance computing and evolutions towards the Cloud and massive data with the Lawrence Berkeley National Laboratory (LBNL) which should lead us to formalize our relations dating back some twenty years.
For the past two years, we have been co-organizing the "Multidisciplinary analysis of high performance data for societal challenges" forum with LBNL.