TIRREX

Autonomous Land Robotics

Ph Bonnifait - R. Lenain

TIRREX

Nicolas Marchand, Project Manager
Jean-François Kong, Executive coordinator

SCIENTIFIC ADVISORY BOARD

- TIRREX Coordinator
- Axes Pilots
- CNRS, INRIA, INRAe, CEA representatives
- Allistene representative
- GdR Robotique representative

EXECUTIVE COMMITTEE

Nicolas Marchand

S. Caro & J-P. Gazeau, O. Stasse, I. Fantoni & F. Ruffier, Ph. Bonnifait & R. Lenain, P. Renaud, G. Laurent

Y. Perrot & R. Béarée, C. Duriez, F. Chaumette & A. Cherubini

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XXL axis

Stéphane Caro
Jean-Pierre Gazeau

XXL robotics platform
>Nantes<

Operational committee
Sc. Manager: S. Caro
Tech. Manager: coming soon
Partners (Advisory):
LIRMM, LS2N, PPRIME

Humanoid axis

Olivier Stasse

RENOIR
>Toulouse<

Operational committee
Sc. Manager: O. Stasse
Tech. Manager: Guilhem Saurel
Partners (Advisory):
IRISA, LAAS, LISSI, LORIA, LS2N

Aerial axis

Isabelle Fantoni
Franck Ruffier

Open-PeRFORm
>Grenoble & Marseille<

Operational committee
Sc. Manager: N. Marchand, F. Ruffier
Tech. Manager: Jonathan Dumon, Julien Diperi
Partners (Advisory):
CITI-lab, GIPSA-lab, Heudiasyc, IRISA, ISM, LAAS LORIA, LS2N, ViBoT

Autonomous land axis

Philippe Bonnifait
Roland Lenain

Roboterrium
>Compiègne, Clermont-Ferrand, Nantes, Lille & Paris<

Operational committee
Sc. Manager: Ph. Bonnifait, Roland Lenain
Tech. Manager: Stéphane Bonnet, Philippe Héritier
Partners (Advisory):
CRIStAL, Heudiasyc, Institut Pascal, LS2N, RITS, TSCF, XLim

Medical axis

Pierre Renaud

TAPSurg
>Strasbourg<

Operational committee
Sc. Manager: Florent Nageotte, Taha Chikhaoui
Tech. Manager: Philippe Zanne, Pierre-Alain Barraud
Partners (Advisory):
CRIStAL, ICube, ISIR, LIRMM, TIMC-Imag

Micro-Nano axis

Guillaume Laurent

Micro Nano Center
>Besançon & Paris<

Operational committee
Sc. Manager: Guillaume Laurent, Mokrane Boudaoud
Tech. Manager: J-Y Rauch, Florian Richer
Partners (Advisory): FEMTO-ST, ISIR

Prototyping & Design

Yann Perrot, Richard Béarée

Operational committee
Sc. Manager: Y. Perrot, J.-P. Gazeau
Partners (Advisory):
CEA List, Institut Pascal, LISPEN, PPRIME

Open infrastructure

Christian Duriez, Nicolas Marchand

Operational committee
Sc. Manager: C. Duriez, N. Marchand
Partners (Advisory):
CEA List, CRIStAL, FEMTO-ST, GIPSA-lab, Heudiasyc, Institut Pascal, ICube, IRISA, ISIR, ISM, LAAS, LIRMM, LISPEN, LORIA, LS2N, PPRIME, TIMC-Imag, TSCF

Manipulation

François Chaumette, Andrea Cherubini

Operational committee
Sc. Manager: F. Chaumette, A. Cherubini
Partners (Advisory):
CRIStAL, Institut Pascal, IRISA, ISIR, LAAS, LIRMM, LS2N, PPrime, TSCF
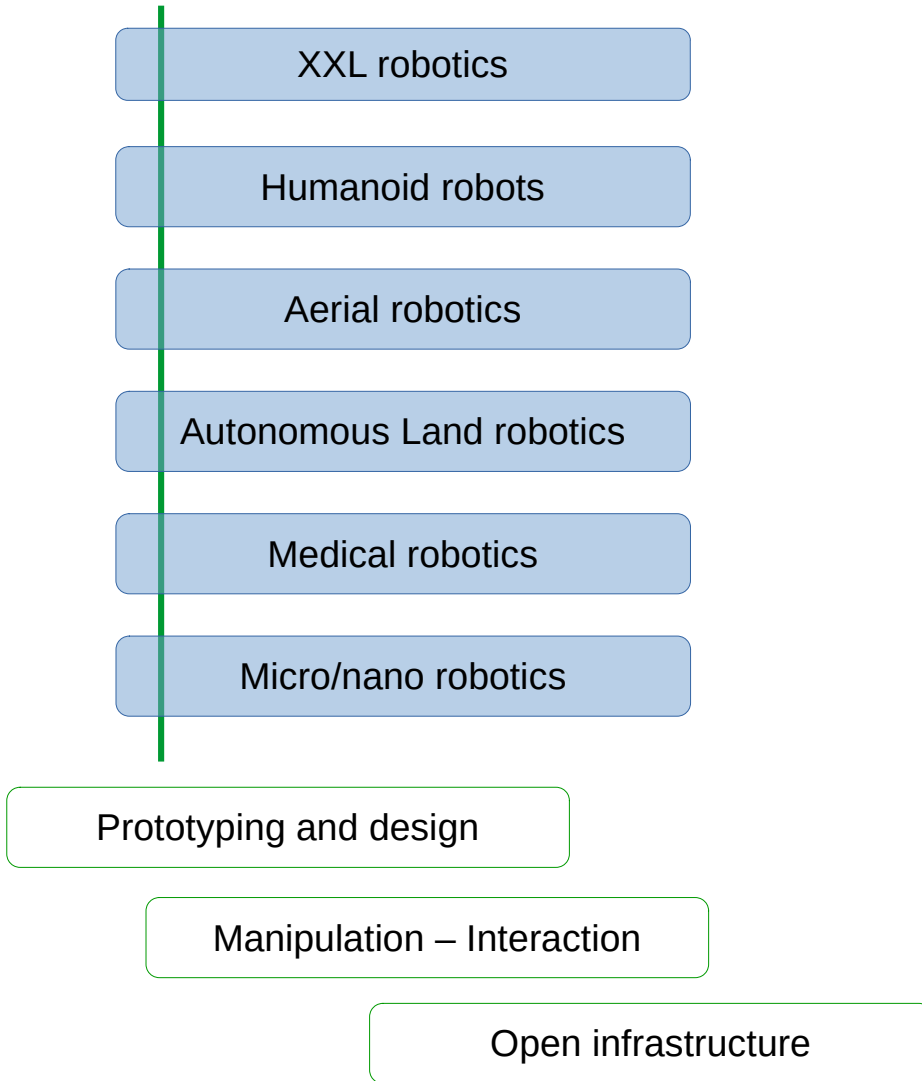
TIRREX

Nicolas Marchand, TIRREX coordinator

Le projet porté par le CNRS-INS2I et soutenu par

- CEA
- INRIA
- INRAe
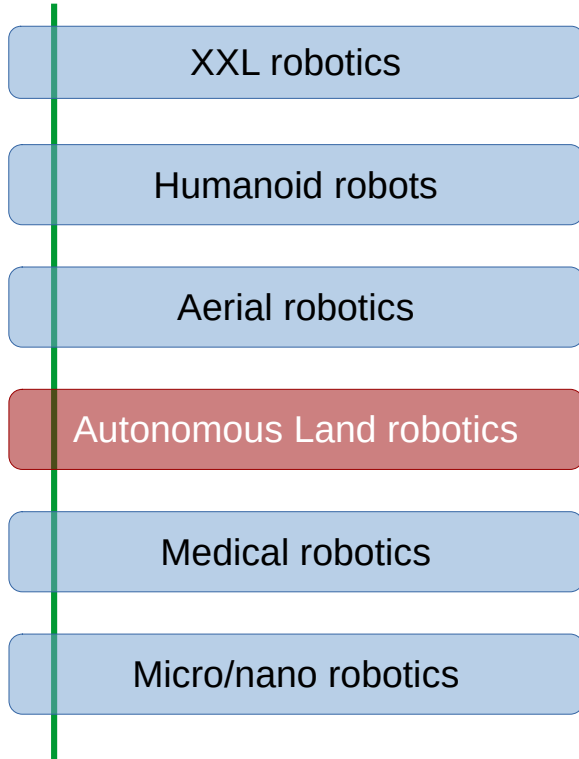- Alliance Allistène
- GDR Robotique

Tirrex project – funded by ANR-Equipex +

- Aims at giving robotic research common equipment

XXL robotics

Humanoid robots

Aerial robotics

Autonomous Land robotics

Medical robotics

Micro/nano robotics

Prototyping and design

Manipulation – Interaction

Open infrastructure

Tirrex project

- Aims at giving robotic research common equipment

| XXL robotics |
| Humanoid robots |
| Aerial robotics |
| Autonomous Land robotics |
| Medical robotics |
| Micro/nano robotics |

Prototyping and design

Manipulation – Interaction

Open infrastructure

Autonomous vehicles

Virtuoz : Toward a common modular and generic platform

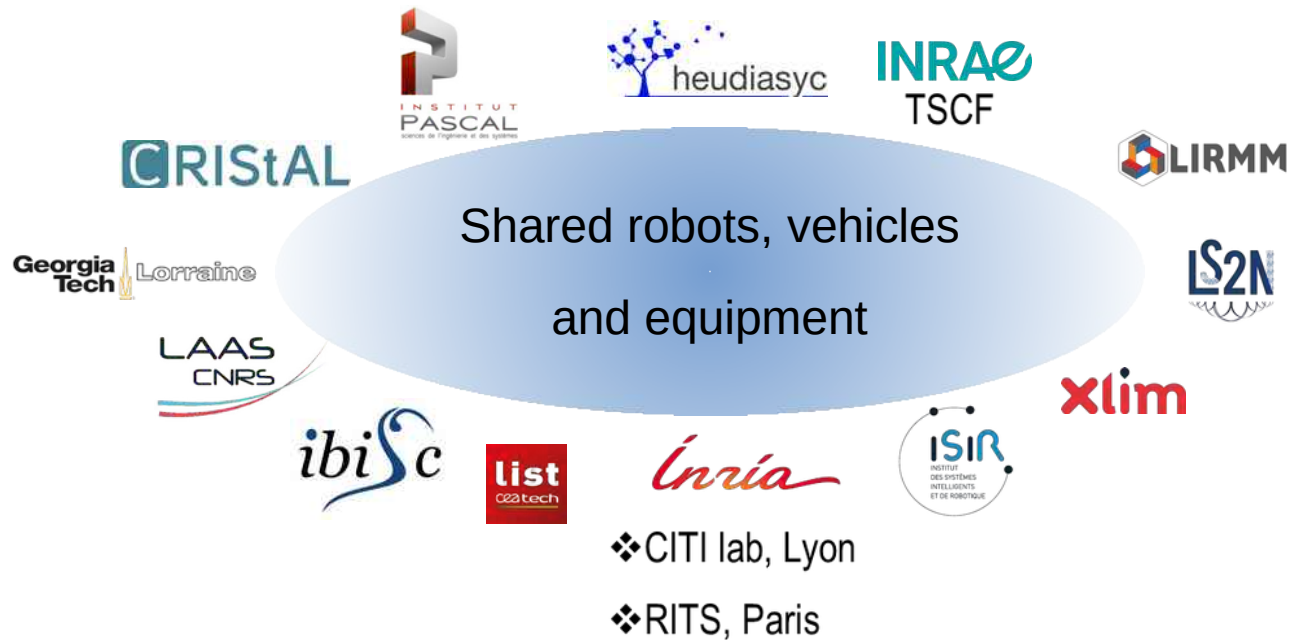Roboterrium : Toward a set of generic off-road robots

Agricultural robots

Tirrex – Autonomous Land Robotics

Step 1: Shared equipment for research

Shared robots, vehicles and equipment

Logos: INSTITUT PASCAL, heudiasyc, INRAE TSCF, CRIStAL, LIRMM, Georgia Tech Lorraine, LS2N, LAAS CNRS, Xlim, ibiSc, list cea tech, Inria, ISIR

❖ CITI lab, Lyon
❖ RITS, Paris

Step 1: Shared equipment for research [2M€]

Tirrex – Autonomous Land Robotics

Intelligent Vehicles

Shared robots, vehicles and equipment

Needs for research

- Develop vehicle autonomy and autonomous navigation
- Integrity monitoring and estimation of autonomy abilities
- Cooperative multi-vehicles
- New human-machine interfaces for shared autonomy

Two "Virtuoz" prototypes + 5 roofs + Test tracks (SEVILLE, PAVIN and Charade)

- V2X standard communication
- HD Maps
- Datasets

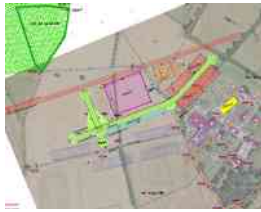- **Equipment for safe testing and data acquisition**
  - Common roof and vehicle interface
  - Shared software and dataset for perception, decision and control
  - Safety drivers
  - Prototyping tool

Tirrex – Autonomous Land Robotics

Agricultural robots

Shared robots, vehicles and equipment

Needs for research

— Off-road mobile manipulation

— Several locomotion modes

— Repetable environment

— Testing infrastructure

— Robots transportation capability

A common site for agricultural robots

— Virtual twin

— Remote supervision for testing

— Datasets for replay

- **Equipment for safe testing and data acquisition**
  - Common simulation testbed, remotely accessible
  - An algorithm database for perception and control
  - Robots monitoring devices
  - Prototyping tool

Issues and open scientific problems

How to adapt robot behaviour

Perception robustness

Parameters adaptation

Situation awarness
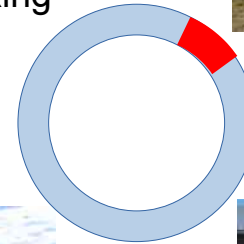
Behaviour adaptation

Environment

action

People tracking

Robot association

Row following

Footprints tracking

Issues and open scientific problems

Perception robustness

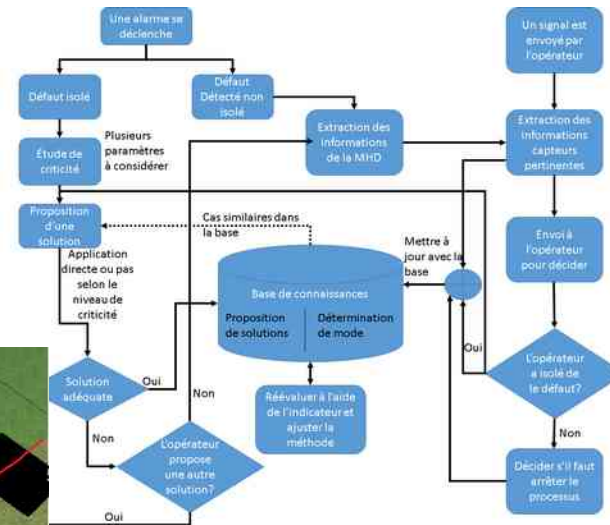How to ensure task integrity

Robot satibility/controllability

Traversability evaluation

Fault detection

Arpa testing - Ref ISO 18497
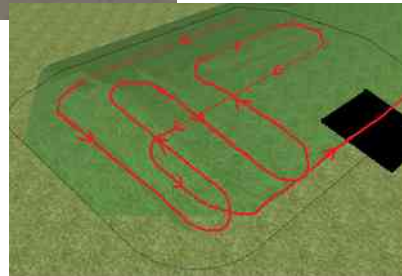
Issues and open scientific problems

Perception robustness

Interaction with soft objects (plant/soil)

Soft body interaction

Redundancy management

Tool motion

@ WUR

Issues and open scientific problems

Easy to use machine

Human machine cooperation

Adaptation to human

Formation control and interaction

Remote supervision

Joining forces to solve scientific locks

How to adapt robot behaviour

How to ensure task integrity

Interaction with soft objects (plant/soil)

Human machine cooperation

…

In nework with agriculture and robotician

Shared operational research actions

Sharing developments and reults

On common devices and dataset

Robotterium

Tirrex – Autonomous Land Robotics

- **A national equipment facilities (Actual and Virtual)**
  - To accelerate research
  - To share results and development about scientific locks
  - An economic model to be proposed
  - To permit tests on various platforms

- **Dedicated to collaborative projects**
  - Open to research community
  - To be used in the framework of projects (ANR, H2020, collaborative)
  - Allow testing reference

- **Open to companies and foreign partners (middle terms)**
  - A business model to access robots within infrastructure
  - Open to any projects
  - Including virtual environment
  - Allowing remote supervision

Tirrex – Autonomous Land Robotics

- Step 2: Definition and coordination of a national research program

Research areas | ...

recognition | safety | perception | Adaptation | Human machine

Work plan

Developments → Virtual test → Experiments
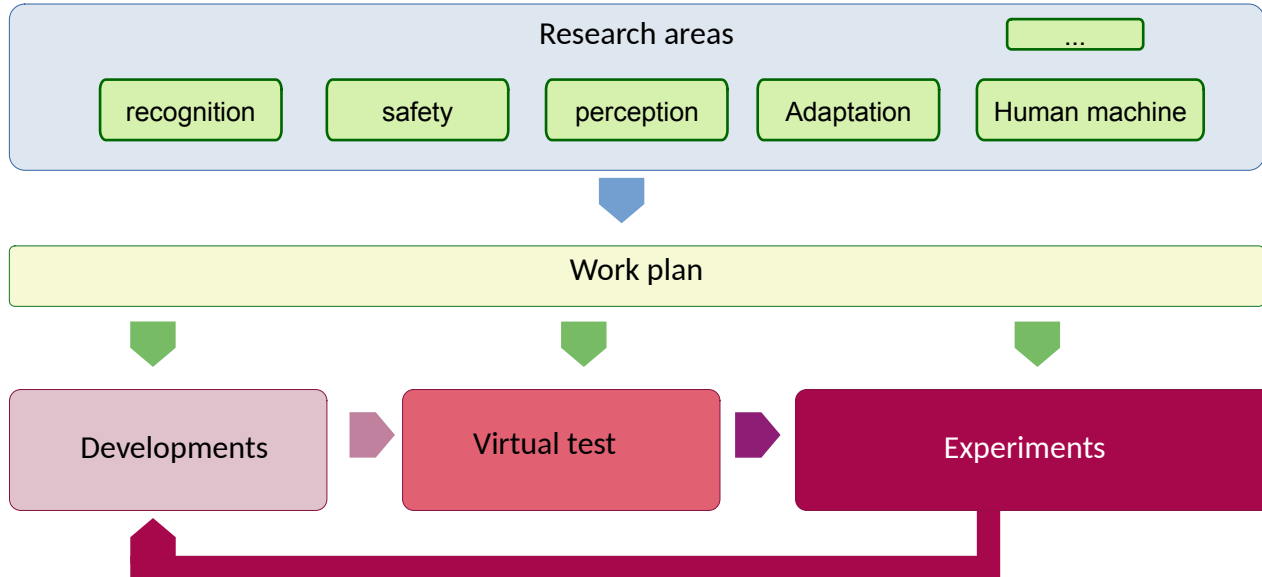
- Step 3: Open to community including private testing

  — Offering on-demand testing and trial

  — Using research equipment

  — An economic model to be proposed

  — Open to external lab and countries and private company

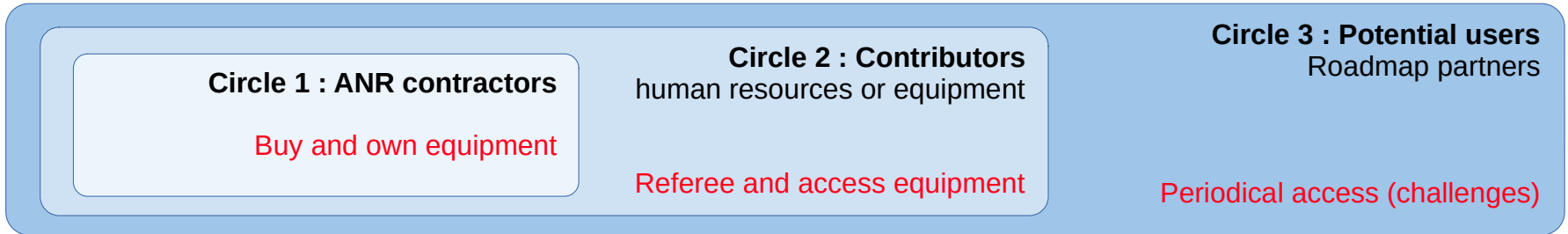# Tirrex – Autonomous Land Robotics

- **Sharing modalities**

Circle 3 : Potential users
Roadmap partners

Circle 2 : Contributors
human resources or equipment

Circle 1 : ANR contractors

Buy and own equipment

Referee and access equipment

Periodical access (challenges)

— Organisation of periodic joint challenge

— Related to the research roadmap

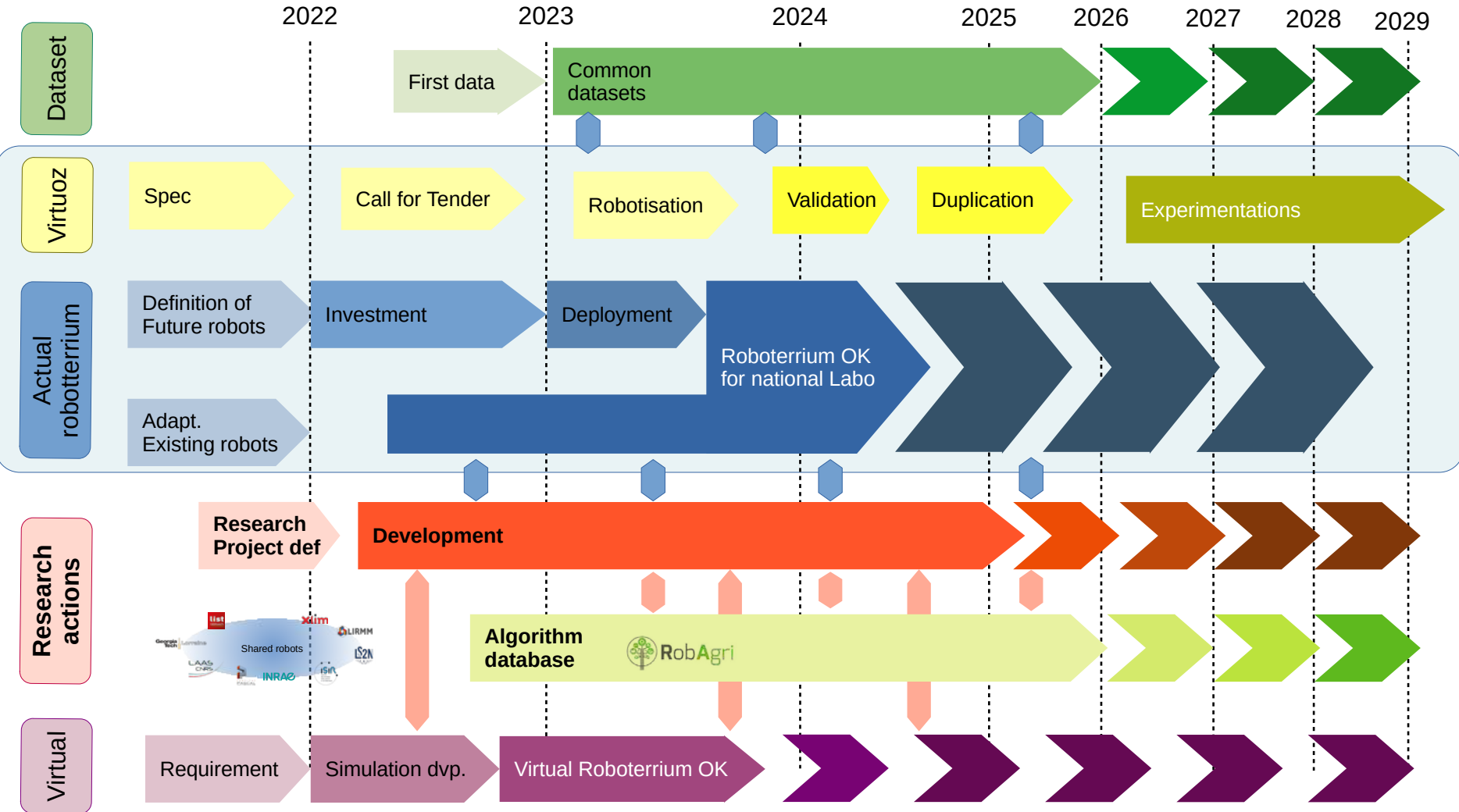➡ Show the complementarity between laboratories and scientific advances

- **Common development tools**

— Numeric twins of equipment

— Shared Libraries for robot control and algorithms

— Sharing dataset

➡ To be build with open infrastructure axis

Tirrex project – funded by ANR-Equipex +

- Planning for investment and availability

	2022	2023	2024	2025	2026	2027	2028	2029

Dataset: First data → Common datasets

Virtuoz: Spec → Call for Tender → Robotisation → Validation → Duplication → Experimentations

Actual robotterrium: Definition of Future robots → Investment → Deployment / Adapt. Existing robots → Roboterrium OK for national Labo

Research actions: Research Project def → Development / Shared robots / Algorithm database — RobAgri

Virtual: Requirement → Simulation dvp. → Virtual Roboterrium OK

Tirrex project – funded by ANR-Equipex +

- Launching Rob@t - 3 main topics:

1 Define a national scientific roadmap
that structures the use of the equipment

2 Identify the needs of each partner
Defining the specification of equipment

3 Identify the contributions of each partner
Robots for Autonomous Land Robotics
Manpower for design and shared software

- How to work on these topics

18/10
14:00

19/10
16:00

9/11
14:00

12/11
10:00

Consultation phase – 4 groups at proposed dates

Identify needs and expectations

Topic of interests

Potential contributions

Synthesis

Poll

Partners prepare 2/3 slides
Subscription at
https://evento.renater.fr/survey/tirrex-selection-seminaire-rob-t-y75njmpk

Seminar Rob@t