



Ninsar

New Itineraries for Agroecology using cooperative Robots

<https://project.inria.fr/ninsar/>

De l'avènement de nouvelles pratiques agro-écologiques par la création de systèmes robotiques collaboratifs



NINSAR Flagship project
PEPR Agroecology and ICT

Wednesday 11th September 2024, Montpellier

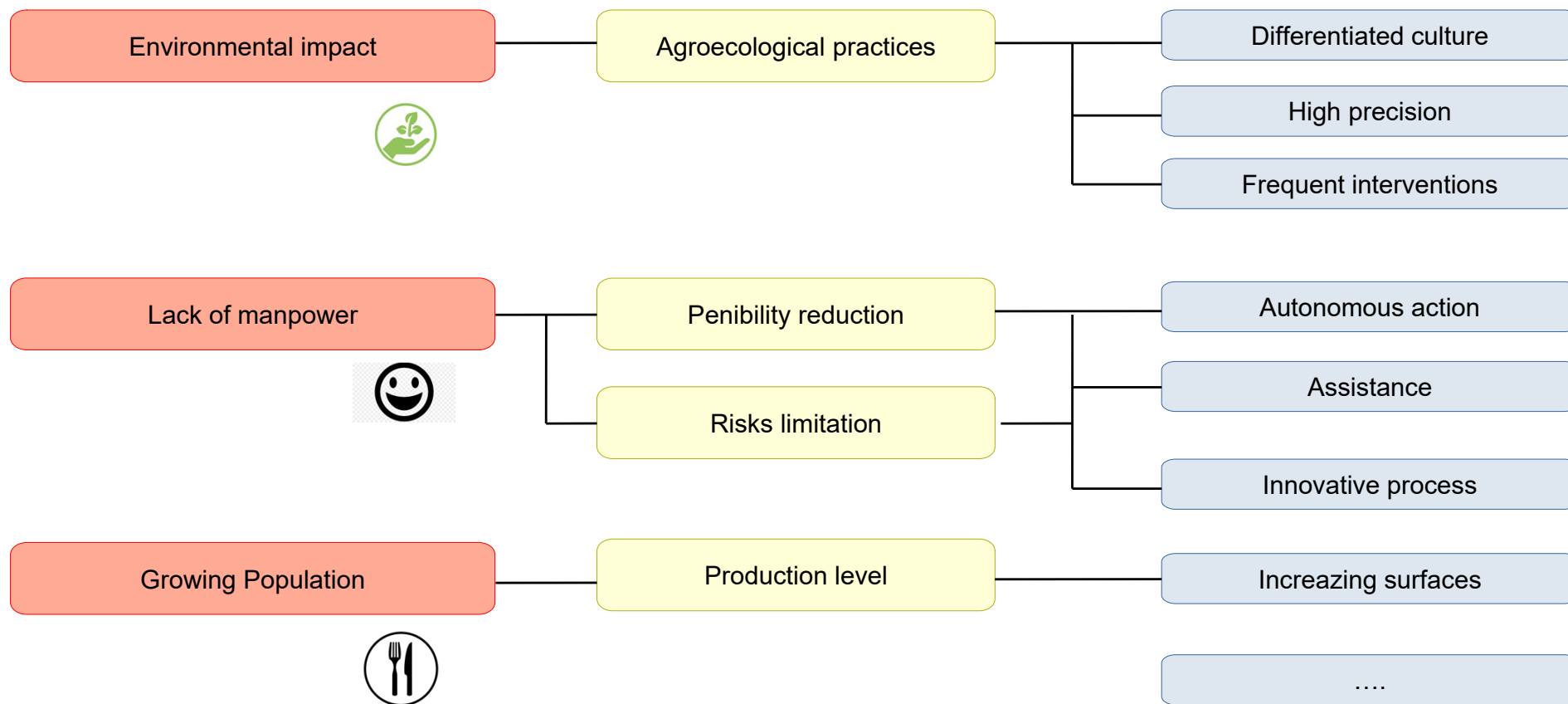
Content

General Presentation

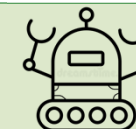
National task force

Two use cases

A societal motivation



How to use robots good for agroecology?



Emerging agricultural tools and robots

Advanced Driving Assistance Systems



Automated driving



Tools Adaptation



Farmer Assistance



Emerging agricultural tools and robots

Toward concept of autonomous tractor

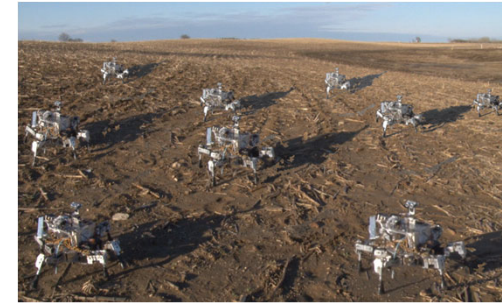


Autonomous tractors



Emerging agricultural tools and robots

The opportunity of defining new concepts ?



New architectures

Different Properties

Adaptable Robotic System



Emerging agricultural tools and robots

Multidisciplinary issues

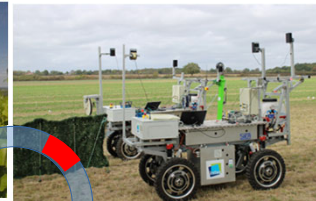
Which **practices** evolution ?



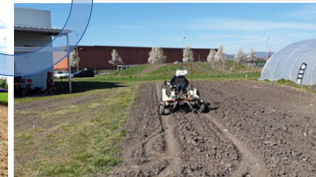
People tracking



Association



Row following



Footprints tracking

How to ensure **safety**?



Detection and avoidance



Accuracy and integrity



Maintaining stability

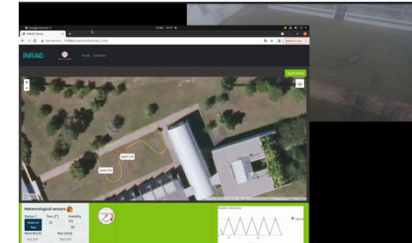
How to **adapt** robots behaviors ?

Adoption of new technologies ?

Cobotic



Supervision tools



Monitoring system



Emerging agricultural tools and robots

Multidisciplinary issues

Which **practices** evolution ?



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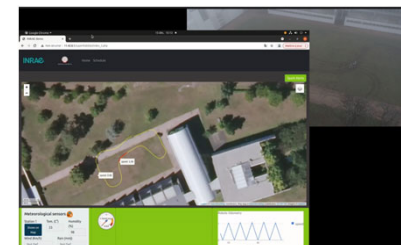
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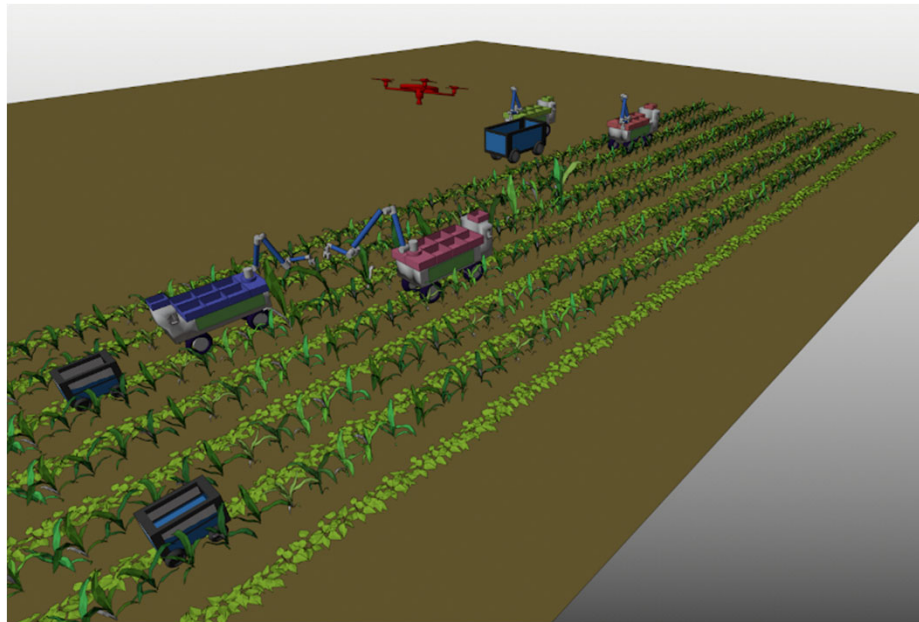
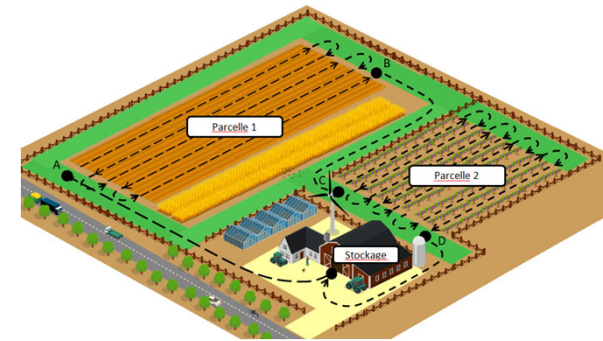
Monitoring system



Project objectives and overview

Toward a reconfigurable fleet of elementary robots

- Able to act at plant scale ... up to multi-robot
- Discriminating vegetation type
- Acting on the crops/soil/weeds
- Optimizing resources regarding the task



Achieving different agricultural operation

- ➔ Soil preparation
- ➔ Sowing seeds
- ➔ Field monitoring
- ➔ Targeted plot maintenance
- ➔ Differentiated Harvest

Project objectives and overview

Allowing the rise of agroecological routes

- At large scale
- Without requiring harsh manpower
- Allowing local and discriminated treatment
- Reducing ressources consumption

Defining robotic agroecological routes

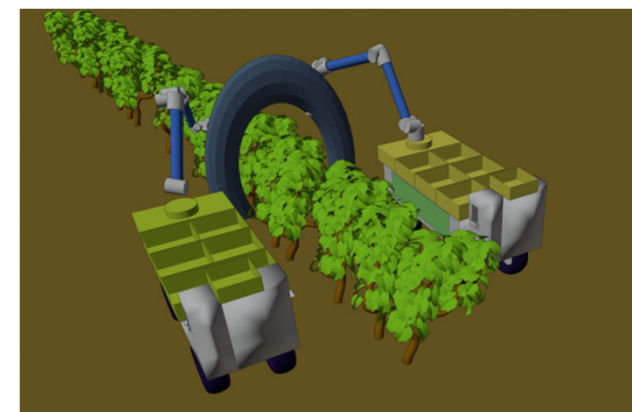
Scouting mission



Large field weeding



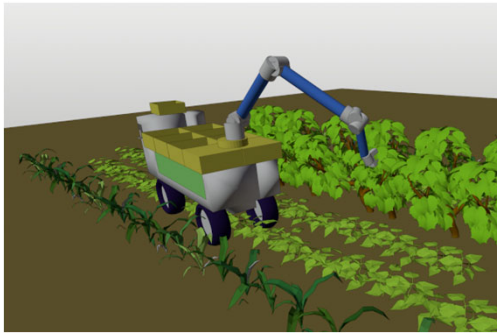
Confined biocontrol spraying/lighting



Project objectives and overview

Defining robotic agroecological routes

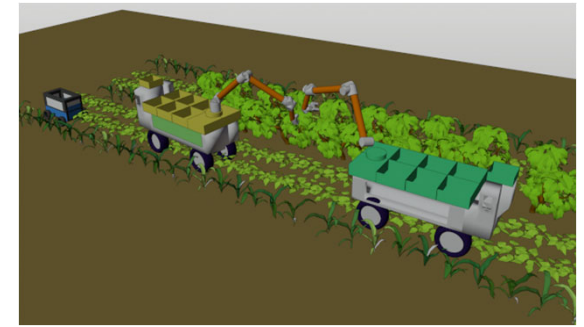
Remove rotten fruit



Local treatment

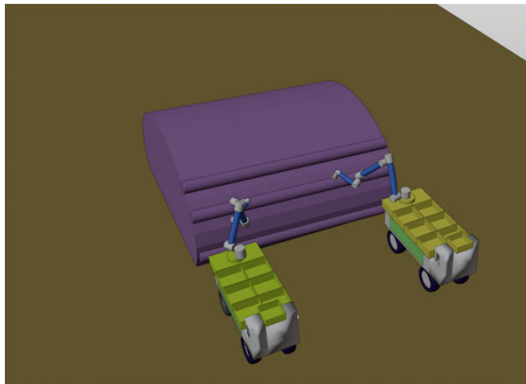


Selected picking



Level of complexity

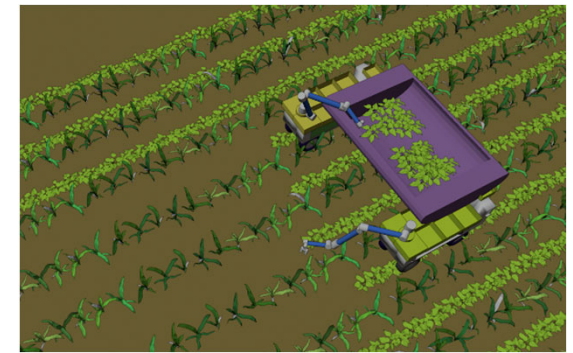
Preliminary sowing



Sowing under cover



Cooperative harvesting



Orchard - Vineyard

Market gardening

Main scientific issues to be addressed

A link between agronomy-ecology and robotics

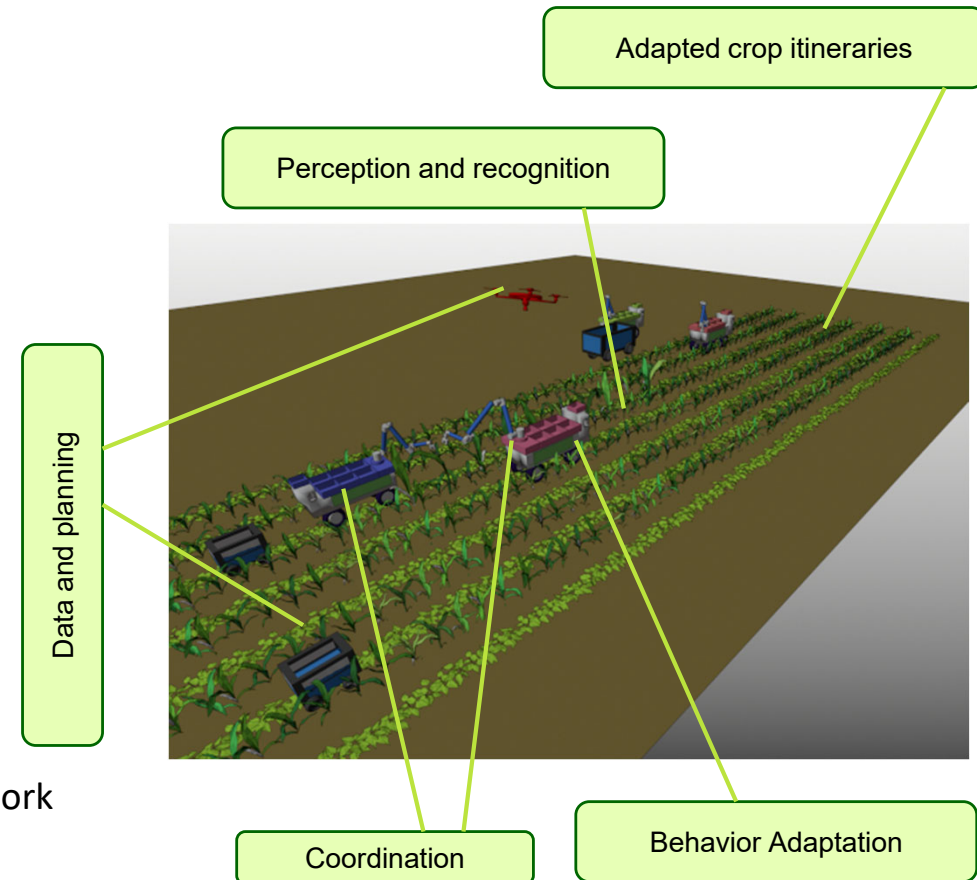
- How to take part of robotics in agroecological process
- Define key robotics behaviors to be improved
- Assess and improve environmental impacts

Robotics challenges

- Multi-robots and tasks planning
- Mobile manipulation
- Real time decision making and task allocation
- Multi-robots on-line reconfiguration
- Data processing
- Robots collaboration and association

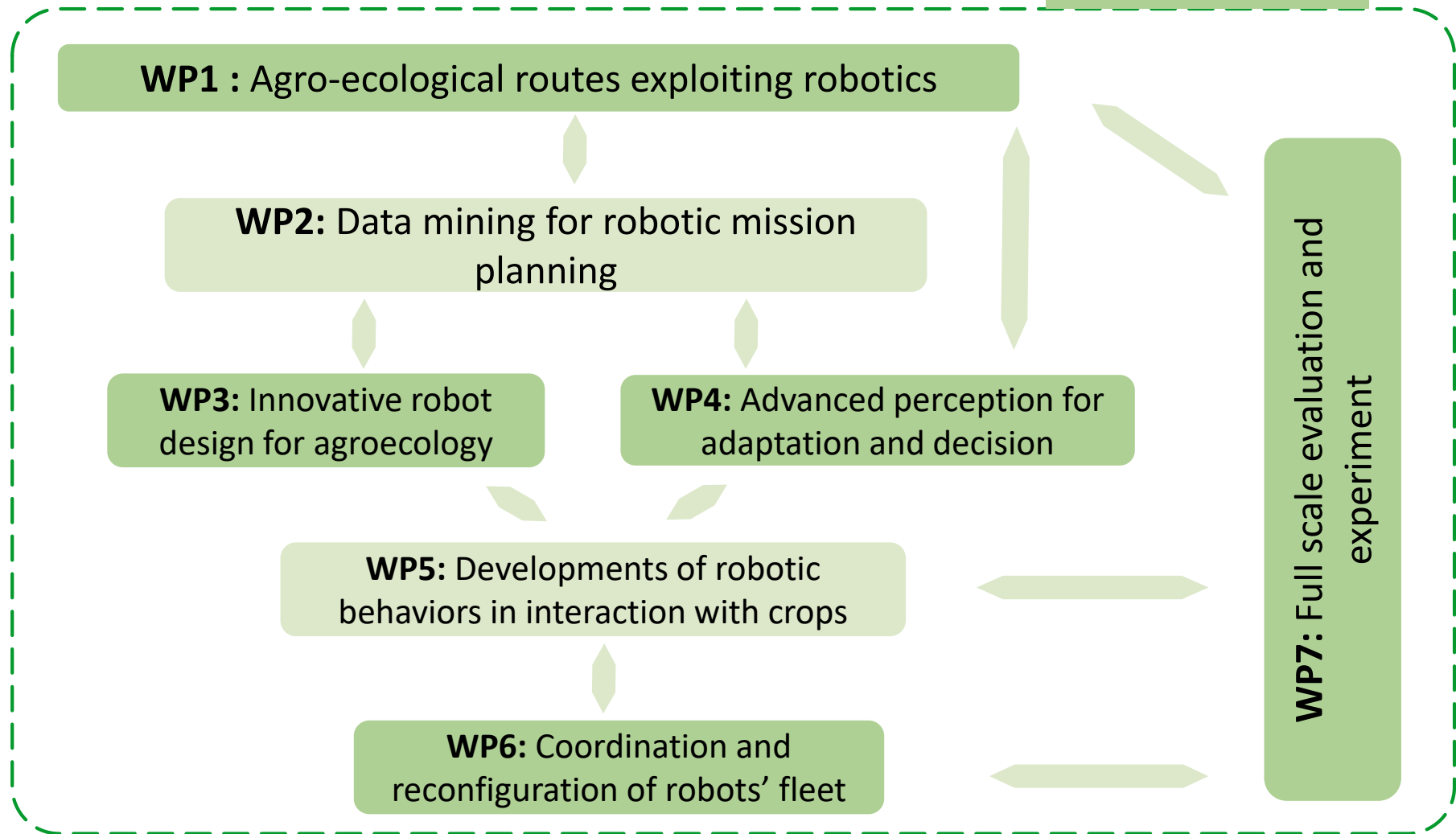
Experimental and shared issues

- Shared material and algorithm through common framework
- Full scale and in field experiments
- Allowing to improve actual agroecological processes

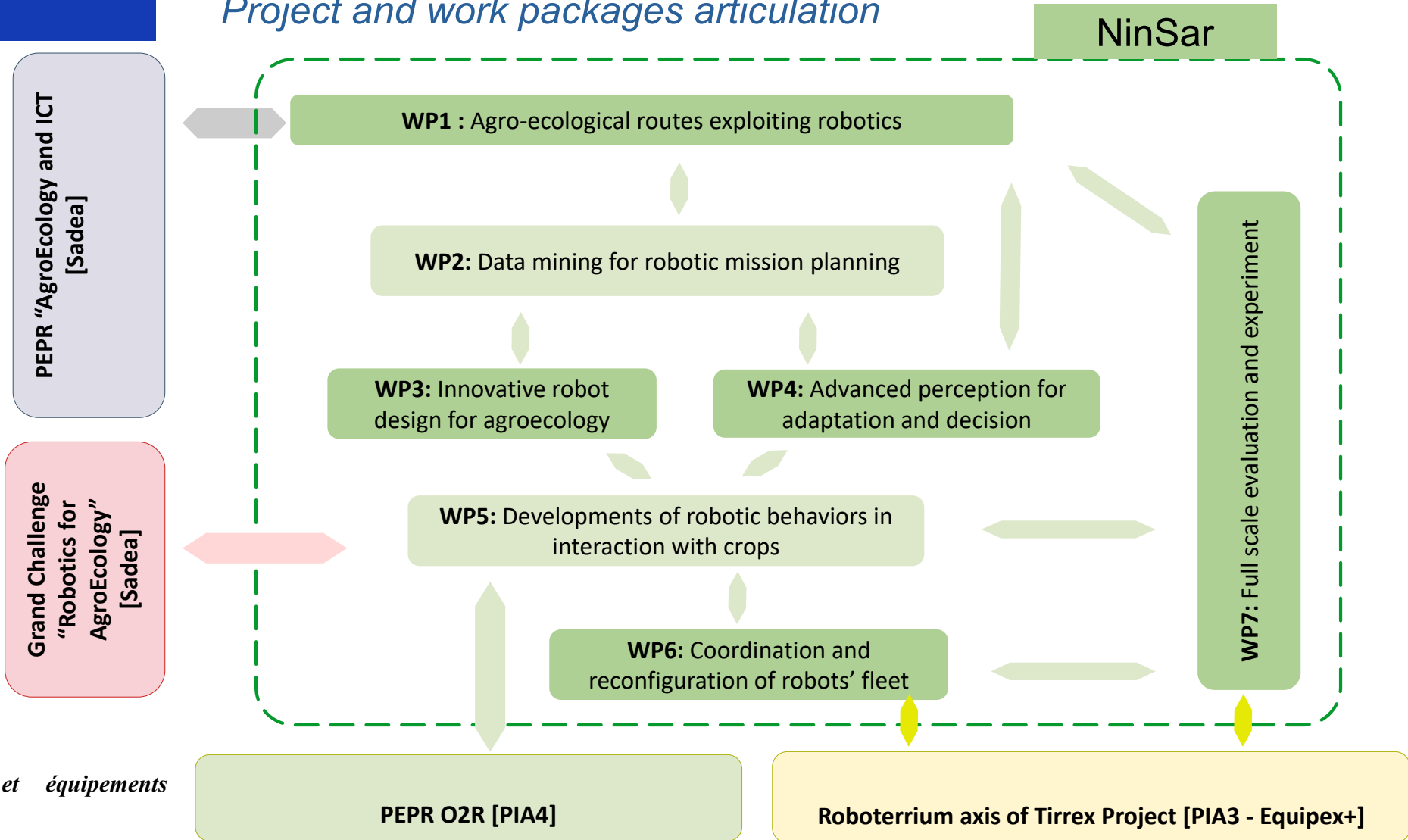


Project and work packages articulation

NinSar



Project and work packages articulation



PEPR: Programmes et équipements prioritaires de recherche

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PEPR Agroecology and ICT

Wednesday 11th September 2024,
Montpellier

Consortium



ACENTAURI CHROMA RAINBOW



ASTRO COPAIN PRE-RTT ROMEA



IRL LAAS XLIM



IP



CRISTAL



ISIR



LS2N



IBISC



LIST



		Situation Awareness													
		Agricultural Practices	Environment assessment	Design	Percep-tion	Inter-pretation	Predic-tion	Deci-sion	Control	Multi robot	AI	Manipu-lation	Super-vision	Commu-nication	
INRAE	Romea														
	PRT-PEE														
	ASTRO														
	Copain														
INRIA	ACENTAURI														
	CHROMA														
	Rainbow														
CNRS-INS2I	CRISTAL														
	IP														
	ISIR														
	LAAS														
	LS2N-ARMEN														
	XLIM-REMIX														
CEA	IRL														
	LIST														
	IBISC														
UniLASALLE															

Primary skill
Secondary skill

Partners expertise and achievement

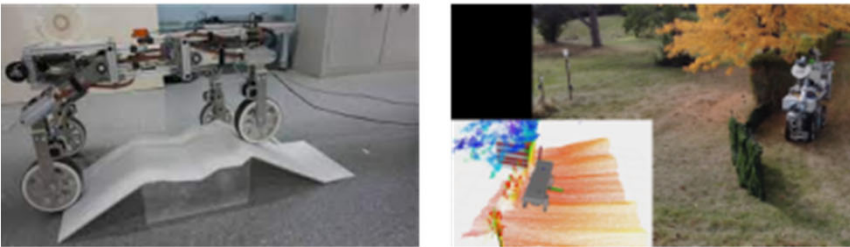
Agroequipment and environment assessment



Localization and environment recognition



Advanced autonomous navigation



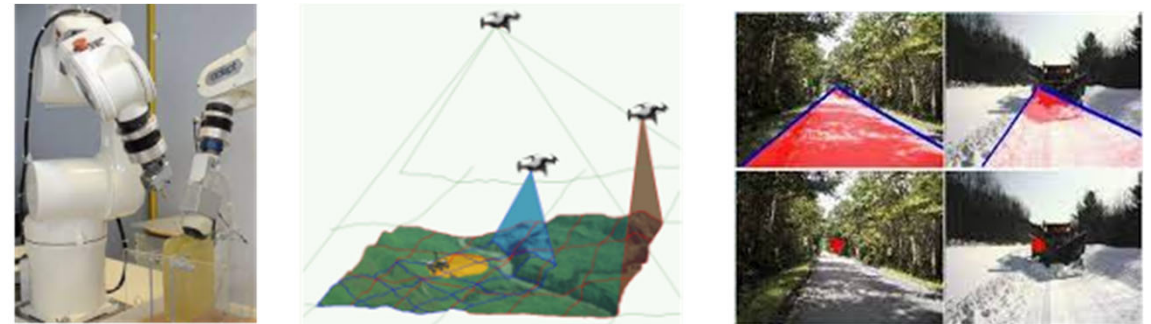
Mobile robots cooperation



Mobile manipulation and treatment



On-line adaptation and decision making



Project ressources

A project centered on human ressources sharing

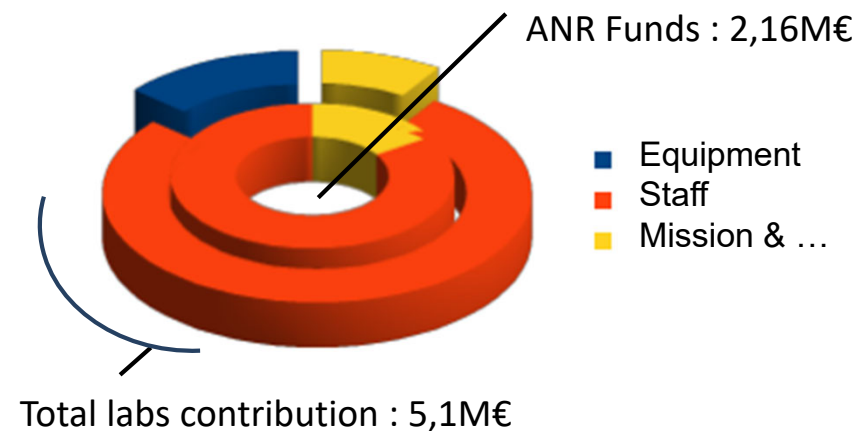
- 6 PhD grants
- 5 Post doctoral Fellow
- 7 engineer contract
- > 50 permanent researcher involved

➔ Equipment aspects managed by roboterrium

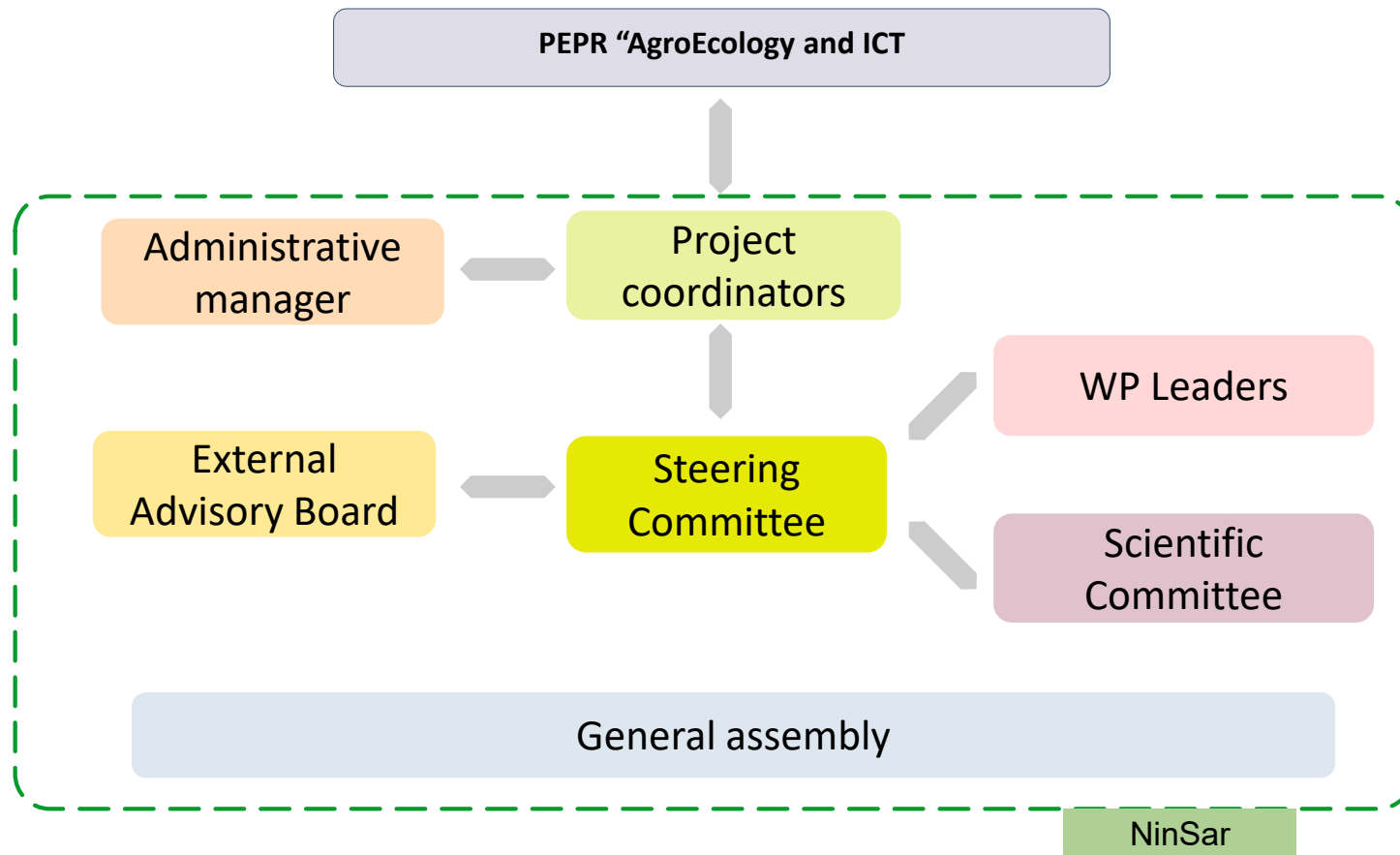
An unbalanced distribution of funds

- Pending on administrative aspects
- Representative of some aspects removal
- Showing labs interest in formal participation
- Agregation of expertise and knowledge

➔ A real collaborative dynamic



Project organization



Expected contributions and outcomes

Challenges centered on robotics

- Multi robots association
- Accurate and discriminate implement control
- Situation awareness and recognition
- Mobile manipulation of soft objects

➔ Generic contributions for robots autonomy

Challenges centered on agroecology

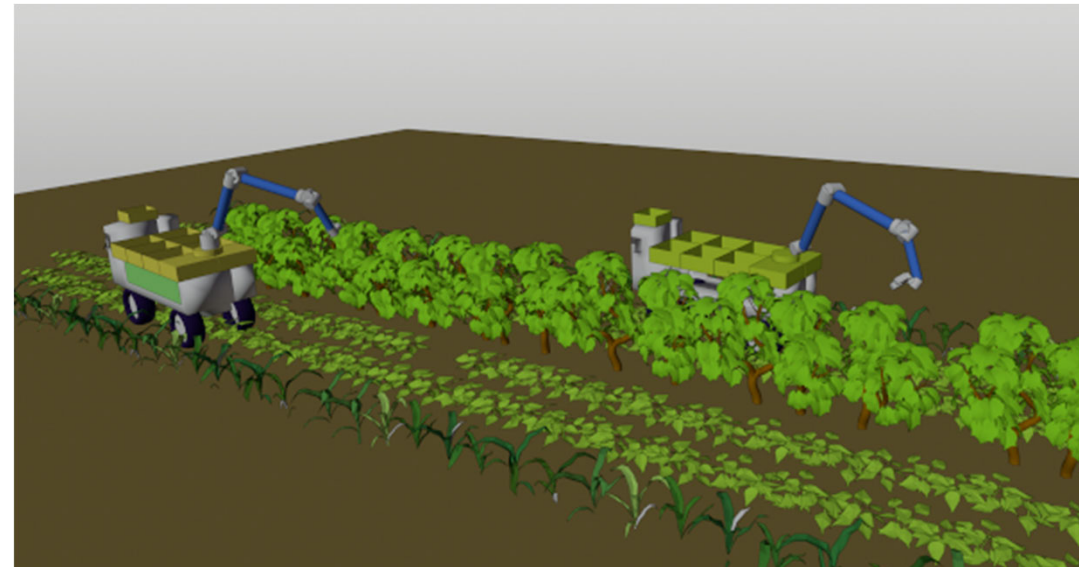
- Define new processes
- New robotics concept for agroequipment
- Short to long term outcomes
- Elementary validation of feasible itineraries

➔ Demonstrate full scale agricultural robots capabilities

Societal and common challenges

- Interdisciplinary projects
- Allowing to share forces and advances
- Shared works for a common application
- Agregation of expertise and knowledge

➔ A real collaborative dynamic for society



Content

General Presentation

National task force

Two use cases

SADEA

Systèmes agricoles durables et équipements agricoles contribuant à la transition écologique

Sadea

PEPR – 60M€
Digital - Robotics - Genetic

AAP – BPI - 90M€

Grand challenge – 22M€
Maturation – Transfer - Structuration

Challenge – ??M€

AAP specific

Flagship projects

AAP Transfer

Devp. tools

PEPR "AgroEcology
and ICT [Sadea]

NinSar

Algo Dvp.

Grand Challenge
"Robotics for AgroEcology"
[Sadea]

Robotics for ecological transition

Interactive mobile
manipulation

PEPR O2R – Organic Robotics
[PIA4]

Roboterrium

Tirrex Project
[PIA3 - Equipex+]



A National Task Force

New tools for new practices

Farmers

Technical Institutes

Manufacturers

Solutions providers

Researchers

Societal challenges

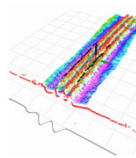
- ✓ Ecological Transition
- ✓ Acceptability and usability
- ✓ Integration and exploitation
- ✓ New practices setup

Technical challenges

- ✓ Perception of the environment
- ✓ Operational safety
- ✓ Cost and robustness

Scientific challenges

- ✓ Robots behaviours adaptation
- ✓ Interactions with vegetation
- ✓ Autonomous systems safety



New robotic technologies available for Agroecological transition

prototypes

Maturation

Challenges

Grand Challenge

PEPR

Sadea : Innovate to succeed agroecological and food transitions

Content

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Two use cases

Use Case 1

2024

Scenario 1: Association of row crops

Automation of existing work

Adaptation of tools and platforms

Operation of light robots



Culture
Spring Barley
Spring protein pea
Spring wheat
Spring field bean
Grain sorghum
Grain Soybean



Use Case 2

Scenario 2: pixel farming

Processing of individual plants
Development of new tools
(Re)design of the agricultural task

Resolution scale

1 pixel = a market gardening board
Planting in boards



1 pixel = a square layout



Line Implantation



1 pixel = one plant





Any questions?